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NOVEMBER 4, 1985

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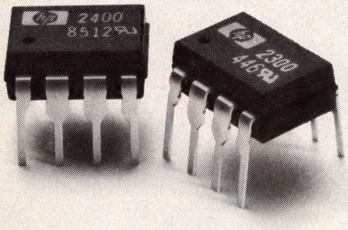

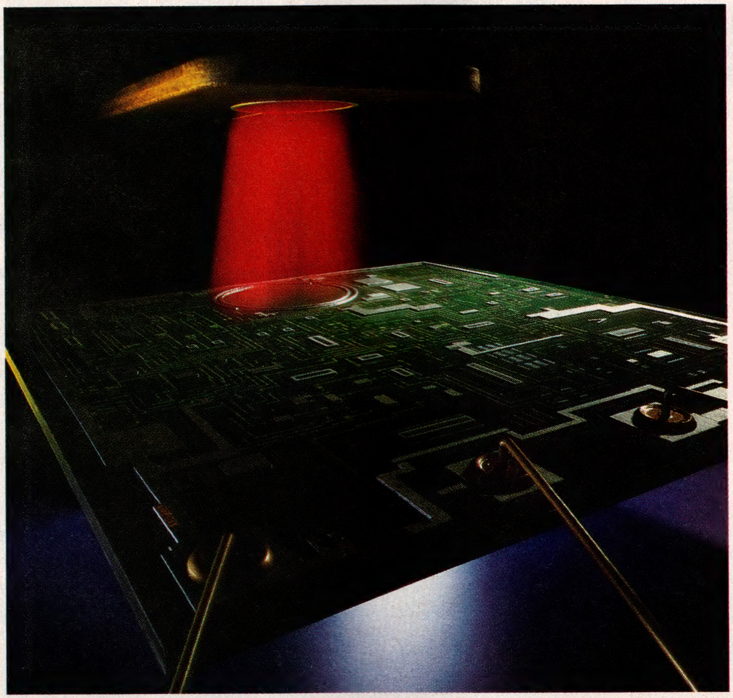

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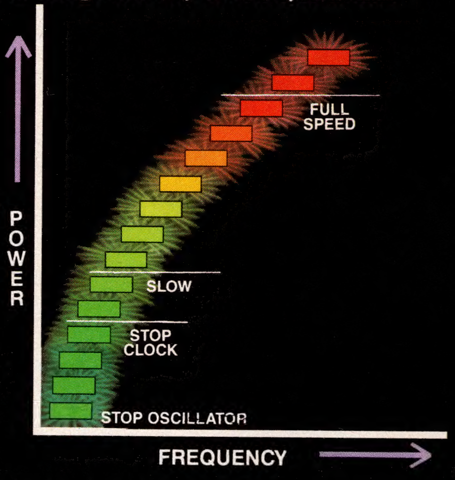

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Electronics

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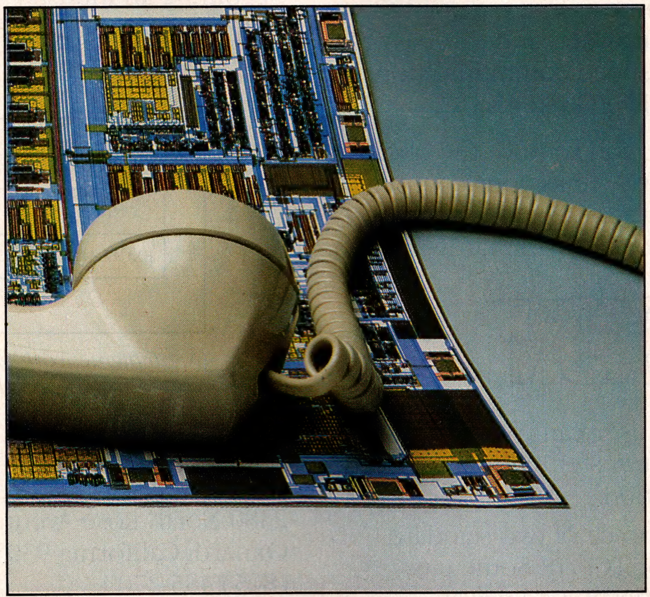

Is trouble coming for modem makers? 50
The advent of single-chip modems will make it a snap for makers to integrate this function in their products. That spells trouble for the makers of stand-alone modems

Cover photo by Walter Chrynwski

True one-chip modem blazes design trail, 46
Sierra Semiconductor is opening up a host of new applications for 1,200-b/s modems with a true one-chip version that can be adapted easily to custom designs

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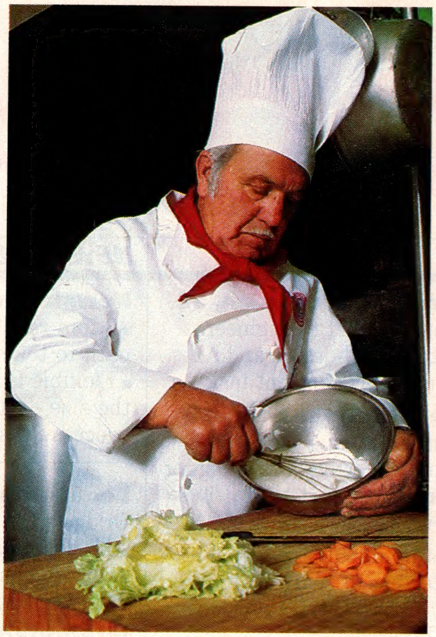

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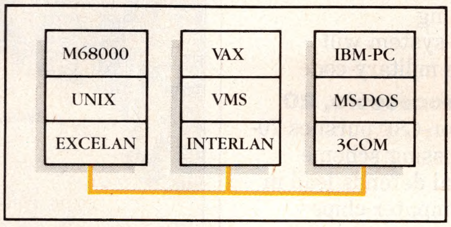

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PUBLISHER'S LETTER

It is axiomatic in just about any business that to stand still is to shrink: there must be continued improvement and refinement of the product. The magazine business is no exception, and the evidence is that we have been fine-tuning *Electronics* for all its 55 years. The result has been the magazine that is the mirror of the electronics industry—one that is known across the nation and the globe as the industry's magazine of record. We developed early in our history the techniques of reporting and placing in perspective the news of technology that have been imitated but never copied by anyone.

The process goes on. Most often, however, the results are not noticeable by themselves but add up to make an evident change: a case of the total exceeding the sum of the parts. However, this week we would like to call your attention to some changes in *Electronics* that are designed to give you more information and make it easier to find—in short, to improve and refine the product.

We are adding more news of technology, and we are not going to waste any time getting to it: right up front, on p. 8, there will be our beefed-up meetings listing. Each week we will select the most important and interesting one and preview it. Also near the front of the issue, on p. 13, you will see the inaugural appearance of a new feature, the Technology Newsletter. It will join our other newsletters in reporting and interpreting the latest news—in this case, the technologies that are driving the industry.

Then, moved forward in the magazine to a position immediately following the main news section, will be our longer technology articles gathered together in a section newly titled Inside Technology. Here (in this issue, on p. 30) will be the familiar technical features: the special reports, Technology to Watch articles, and, due to make its debut next week, a new class of article that will survey a particular aspect of technology—more or less a feature that will probe the hottest and newest of the technologies.

Following this will be the Probing the News articles, examining in depth the latest developments of business and technology. This is followed by the Companies and Bottom Lines features, which dig into the business side. They will be teamed with the *Electronics* Index and will be followed by the People pages, which will also feature a new look and a new department, People on the Move—shorter items designed to track the week's most important personnel changes in the industry.

Finally, we have moved the popular Electronics Week news feature to the last page of the magazine, where it will serve as a fitting coda to each issue: a collection of short late-breaking news stories covering the developments that are significant, though not necessarily the most significant of the week.

All these moves will make *Electronics* more valuable to you, and we promise to continue to make changes and additions—although not always quite so many each week—with that as our objective. The feeling around our offices these days is that we're not getting older, just better.

Laurence Altman

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MEETINGS

MEMORY WILL BE A HOT TOPIC AT IEDM

WASHINGTON

Memory technology will be a major focus of this year's International Electron Devices Meeting (see listing below), says Gregory H. Olsen, president of Epitaxx Inc. and one of the conference's organizers.

Conference officials expect about 1,700 participants; about two thirds of the 179 papers will be from the U.S. and 23% from Japan. In memory technology, Olsen notes, "many of the breakthroughs are coming from Japan."

Nonetheless, one of the more interesting papers on the subject describes a cell structure from Texas Instruments Inc., Dallas. The structure, which TI says is suitable for construction of a 4-Mb dynamic random-access memory, lays out in 9 μm^2 as a crosspoint-array element, with both the capacitor and the pass transistor of a memory cell fabricated on the sidewalls of a 1.3-by-1.5-μm^2 trench. One of the memory-technology advances from Japan is an erasable programmable read-only-memory cell from Toshiba Corp., Kawasaki, which uses a polysilicon sidewall as a floating gate along the fringe of the control gates.

IEDM: 31st International Electron Devices Meeting, IEEE (Electron Devices Society of the IEEE, 655 15th St. N.W., Suite 300, Washington, D.C. 20005), Washington Hilton and Towers Hotel, Dec. 1-4.

Softfair II, IEEE (Softfair II, P.O. Box 639, Silver Spring, Md. 20901), Cathedral Hill Hotel, San Francisco, Dec. 2-4.

Globecom '85: IEEE Global Telecommunications Conference, IEEE (G. A. Ledbetter, South Central Bell, 365 Canal St., New Orleans, La. 70140), Hyatt Regency, New Orleans, Dec. 2-5.

Materials Research Society Fall Meeting, Materials Research Society (9800 McKnight Rd., Suite 327, Pittsburgh, Pa. 15237), Marriott Hotel at Copley Place, Boston, Dec. 2-6.

Lasers '85, Society of Optical and Quantum Electronics (P.O. Box 245, McLean, Va. 22101), Sahara Hotel, Las Vegas, Dec. 2-6.

IEEE Semiconductor Interface Specialists' Conference, IEEE (Peter S. Winokur, Sandia National Laboratories, Division 2144, Albuquerque, N.M. 87185), Bonaventure Hotel, Fort Lauderdale, Fla., Dec. 4-7.

1985 Power Semiconductor Devices Workshop, IEEE and National Bureau of Standards (Sandra B. Kelley, NBS, Building 225, Room B3444, Gaithersburg, Md. 20899), NBS Facility, Washington, Dec. 5.

IEEE-SISC: IEEE Semiconductor Interface Specialists Conference, IEEE (R. Daniel McGrath, Texas Instruments Central Research Laboratories, P.O. Box 225936, Dallas, Texas 75265), Bonaventure Hotel, Fort Lauderdale, Fla., Dec. 5-7.

1985 Videodisc, Optical Disk, and Compact Disc Conference & Exposition, Meckler Publishing (11 Ferry Lane W., Westport, Conn., 06880), Wyndham Franklin Plaza, Philadelphia, Dec. 9-12.

17th National Data Systems Forum and Exhibit, Electronic Data Interchange Association (Transportation Data Coordinating Committee, EDIA, 1101 17th St. N.W., Washington, D.C. 20036-4775), Hilton Hotel, Washington, Dec. 10-11.

WSC '85: Winter Simulation Conference, IEEE *et al.* (Gerard C. Blais, U.S. Air Force, Washington, D.C. 20330), San Francisco Hilton and Tower, Dec. 11-13.

CAIA: Second Conference on Artificial Intelligence Applications, IEEE (Artificial Intelligence, 1730 Massachusetts Ave. N.W., Washington, D.C., 20036), Fontainebleau Hotel, Miami Beach, Fla., Dec. 11-13.

Winter National Design Engineering Show & Conference, American Society of Mechanical Engineers (Cahners Exposition Group Inc., 999 Summer St., Stamford, Conn. 06905), Convention Center, Anaheim, Calif., Dec. 11-13.

24th IEEE Conference on Decision and Control, IEEE (David S. Spain, Advanced Information & Decision Systems Co., 210 San Antonio Circle, Suite 286, Mountain View, Calif. 94020-1270), Bonaventure Hotel, Fort Lauderdale, Fla., Dec. 11-13.

1st International Conference on Supercomputing Systems, IEEE (Supercomputing Conference, 1730 Massachusetts Ave. N.W., Washington, D.C., 20036), Innisbrook Resort, Tarpon Springs, Fla., Dec. 16-20.

5th Symposium on Reliability in Distributed Software and Database Systems, IEEE (IEEE Computer Society, 1730 Massachusetts Ave. N.W., Washington, D.C., 20036), Los Angeles Marriott, Jan. 13-16.

1986 Reliability and Maintainability Symposium, IEEE (Norman Kutner, Westinghouse Electric Corp., 401 E. Handy Ave., Sunnyvale, Calif. 94088), Riviera Hotel, Las Vegas, Jan. 21-23.

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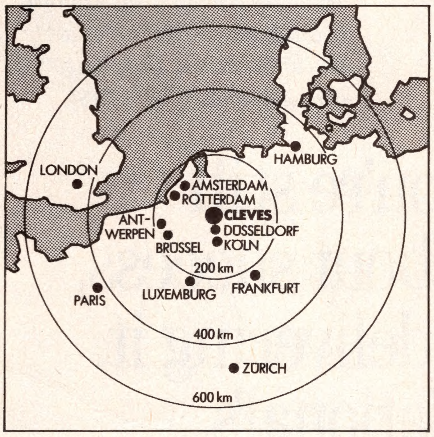

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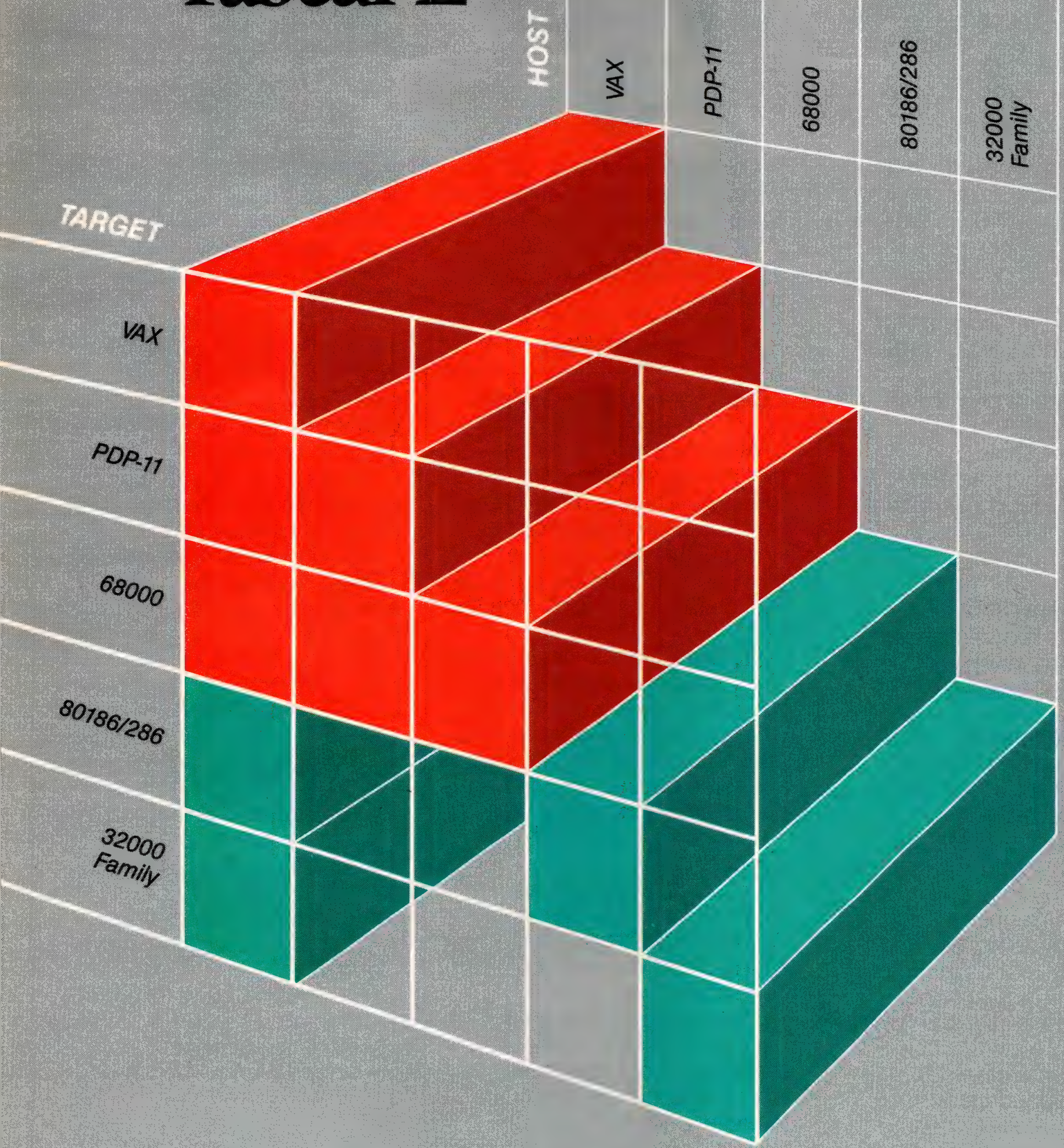

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WEEK 2

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For openers, the Am7960 drives coax, twisted-pair, infrared or fiber optics. There's no need to redesign your wiring.

Am7960

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WEEK 3

Our high-speed Am8751 programmable single-chip microcomputer will easily take your clock pulse rate to 12 million per second. At 12MHz, no other 8751 is faster.

Am8751/9761

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Nor is any 8751 better for prototyping, since you can run at full speed. There is no quicker way to get into production.

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Our Am8751 also programs in just a handful of heartbeats—4K bytes in 13 seconds. So we raise your productivity by shaving a full three minutes off the current, and somewhat lethargic, industry programming record.

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Hands down, the Am8751 and Am9761 are top performers in this popular microcomputer family.

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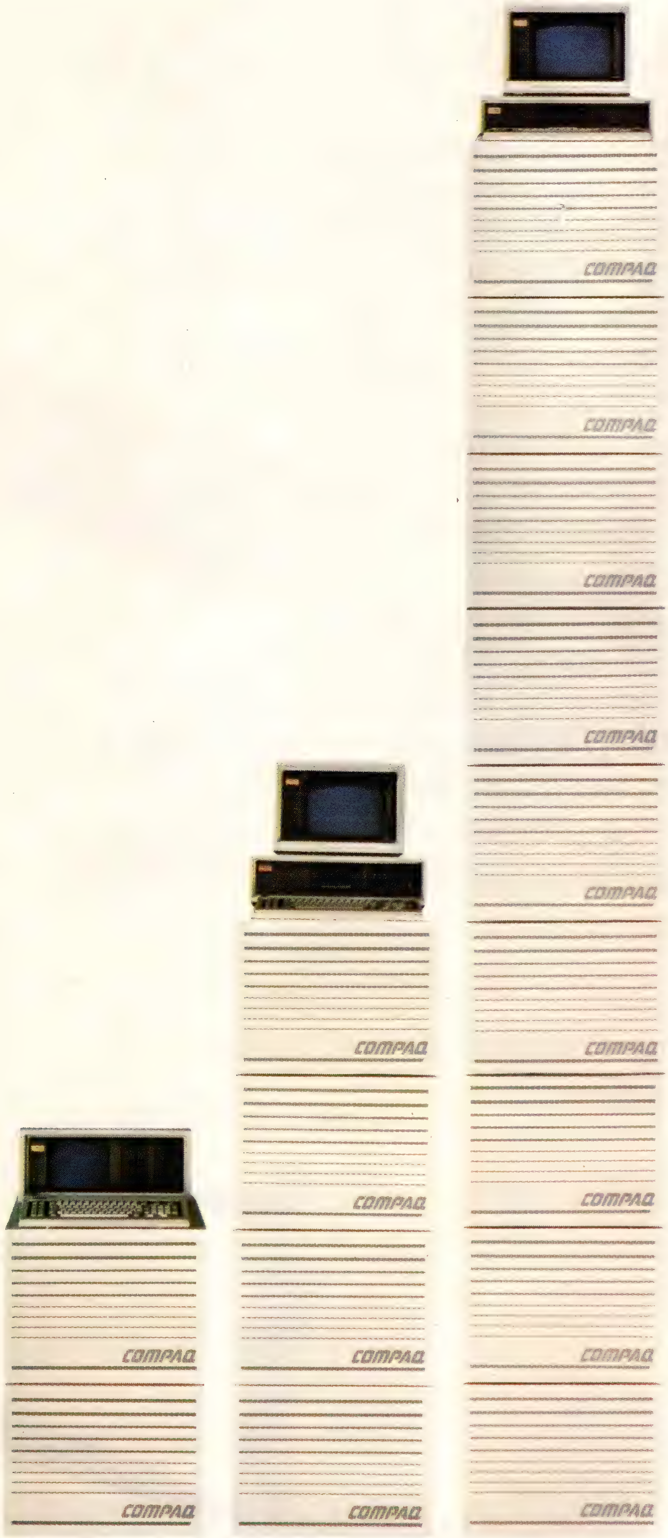

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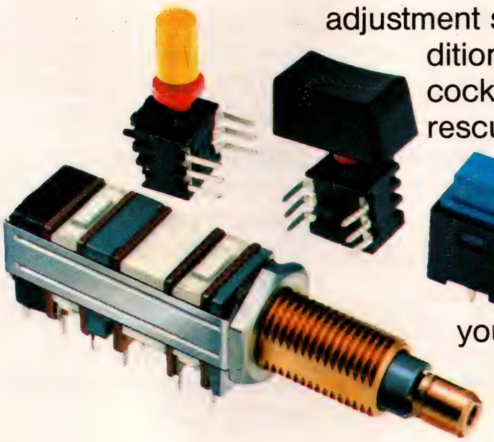

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NOVEMBER 4, 1985

TECHNOLOGY NEWSLETTER

HAZELTINE DEVELOPS 'FLOATING' FET FOR SIGNAL PROCESSING

Hazeltine Corp. has come up with a versatile new device—a "floating" field-effect transistor—for a wide range of signal-processing applications at microwave frequencies, including amplification, mixing, correlation, phase detection, modulation, and frequency multiplication. The gallium arsenide circuit, designed by Carmine Vasile, a consultant to the Greenlawn, N. Y., company, consists of an electrically symmetrical FET whose drain and source float with respect to ground. They are connected to the output port through a balun, a center-tapped transformer, or a differential amplifier. Vasile will describe the circuit at the Government Microcircuit Applications Conference '85 in Orlando, Fla., this week. ☐

DATA-TRANSFER STANDARD NEARS FOR OPTICAL DRIVES

Complete specification of an optical-disk-drive extension of the Enhanced Small Disk Interface, a private industry standard that supports 10-Mb/s data transfer to and from peripherals, has only one hurdle left: agreement on the number of gaps between header and data bits. Meeting in Denver, an ad hoc committee of drive and controller makers added a specification for erasable optical drives to the existing write-once draft. The ESDI committee is now surveying controller makers about their preferred header gap count in preparation for a January meeting of the complete ESDI committee. ☐

SILICONIX PLANT CLAIMS SUPER-CLEAN STATUS

Class-1 certification status, representing a tremendous jump in wafer-plant cleanliness, has been achieved by Siliconix Inc.'s new 6-in.-wafer-fabrication plant now on line in Santa Clara, Calif. The first U. S. plant to gain Class 1 cleanliness, the Siliconix fab line tested at less than one particle of dust greater than 0.2 μm in diameter per cubic foot of air, the company claims. Class-1 certification requires less than one 0.5-μm particle per ft^3. The new fab can now turn out 2,000 wafers per month. ☐

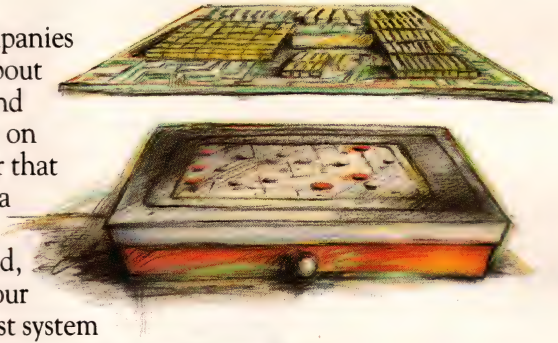
MINISUPERCOMPUTER SEGREGATES MATH TASKS FROM MANAGERIAL FUNCTIONS

Another system joins the new "minisupercomputer" class of scientific computers. Culler Scientific Systems Corp. last week introduced its Culler 7 family, with models ranging in performance from 7 million instructions per second and 2 million floating-point operations per second to 36 mips and 16 megaflops. The Culler architecture segregates the mathematical calculations from the operating-system's managerial functions—one to four 64-bit computational processors do calculations while a 32-bit kernel processor handles the system operation, which involves many short tasks and frequent context switches. Each proprietary computational processor is built to perform several functions during each clock cycle. Integer and single-precision floating-point instructions are performed in one clock cycle while double-precision floating-point operations compute in two cycles in the TTL processors. ☐

VIDEO-DISK PLAYERS WILL USE PHOTO FILM AS MEDIUM

A new lower-cost medium for video disks will make its debut next May when McDonnell Douglas Electronics Co. starts selling laser video-disk players that use disks coated with standard photographic film. The players, intended for institutional use, were developed jointly with Sansui Electric Co., Tokyo. The disks, measuring 300 mm in diameter, can be processed in an ordinary darkroom and require less expensive facilities and equipment than disks now in use, says the St. Charles, Mo., company. ☐

No One Should Have To Settle For A Mid-Range Tester That Can't Ever Be Anything More.



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In any configuration, the 2276 gives you twice the data rate and four times the memory depth of most other testers. When fully expanded, it gives you a 20 MHz clock and the only full-cell, 1-megabit memory tests in the industry. And when you add the J-11™ processor option, you can cut test time by as much as 50 percent.

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NOVEMBER 4, 1985

ELECTRONICS NEWSLETTER

NEC MAY HAVE PUSHED BY TI AS LARGEST CHIP VENDOR

Japan's NEC Corp. apparently has moved into the top spot as the largest supplier of integrated circuits in the world, dealing another blow to the prestige of the U. S. semiconductor industry. Based on estimated 1985 chip revenue, NEC has pushed long-time leader Texas Instruments Inc. down to the No. 2 position. That's the preliminary finding of Integrated Circuit Engineering Corp., the Scottsdale, Ariz., market research company that each year ranks the major chip vendors. What's more, Hitachi Ltd. looks to have edged past Motorola Inc. as the third largest chip supplier in the world, sending Motorola Inc. to the No. 4 position, ICE estimates. ☐

APPLE PLANS MACINTOSH LINKS TO IBM'S TOKEN-RING NET

Don't count Apple Computer Inc. out as a force in the office-automation business. The Cupertino, Calif., company dealt itself back into the market last week when its president John Sculley indicated that Apple would link its Macintosh to IBM Corp. Personal Computers through IBM's Token-Ring Network. Previously, Apple had announced—but not delivered—a board that would hook a PC into the low-speed (250-kb/s) Macintosh Appletalk network. Apart from that board and third-party products such as the 3Com Corp. Ethermac server and a software program that turned the Mac into a dumb terminal on an IBM net, the 32-bit Mac was pretty much isolated in offices. Industry sources expect a Macintosh file server that can work with the Token-Ring Network will be announced as ready for delivery by Convergent Technologies Inc. of San Jose this week. Apple has traditionally been slow in developing network products, and analyst Louise Wells of Dataquest Inc., San Jose, Calif., said the company may well encourage further third-party development of gateways into IBM nets. ☐

FCC APPROVES TWO AT&T BUSINESS SERVICES

The Federal Communications Commission late last week approved AT&T Co.'s new software-defined network and a service designed for very high-volume long-distance customers. The action came despite claims by local switched networks that the services would promote bypassing of local carriers and drain billions of dollars from their revenues. The software-defined network would permit users to obtain private-line service using AT&T's central-office-switching facilities; AT&T's Megacom service would give heavy users lower rates by either bypassing the local network through direct connections or by using local connections at prices that wouldn't include access fees. The FCC will monitor both services to determine whether AT&T's "compensatory rates" are justified, however. In making the decision, the FCC argued that business customers needing the two services usually do not use the local exchange and that it expects fewer than 0.1% of the local carriers' customers to migrate. Tariffs for the services take effect this week. ☐

BENDIX BIDS FOR THOMSON'S CONNECTOR BUSINESS

The Bendix Corp. subsidiary of Allied-Signal Corp. will gain a major foothold in the European connectors market with the purchase of Thomson-CSF subsidiary Socapex. The U. S. company's offer of some $40 million, which almost equals the total 1984 sales figure for the 1,000-employee company, coincided with Thomson president Alain Gomez's decision to sell off activities in the company's components branch that he did not consider to be of essential strategic importance. Socapex produces a broad range of electrical and optical-fiber connectors for data-processing, telecommunications, and military applications. ☐

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DT2805/5716	✓	✓	✓					✓	2070
DT2808	✓	✓						✓	495
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PRODUCTS NEWSLETTER

3COM READIES ETHERNET PATH TO TOKEN-RING NETWORKS

Software that 3Com Corp. plans to release in January will give the Mountain View, Calif., company's Ethernet local-area networks multiuser capability and an eventual path to token-ring LANs. The 3+ series is based on Microsoft Corp.'s DOS 3.1 multiuser operating system. One package, 3+ Share, enables personal computers to share files and peripherals. Other software transparently links LANs that use Xerox Corp. XNS protocols and upgrades 3Com's present Etherseries to permit file as well as disk sharing. When connected by a gateway to a token ring, the software will enable computers connected by Ethernets and token rings to share information. The 3+ Share module, which supports up to five users, will sell for $550. 3+ Route, the product that links different networks, will sell for $1,250. ☐

FLEXIBLE PARES SIZE OF PARALLEL PROCESSORS

The big processing punch of parallel multicomputing is coming in smaller boxes, as the introduction of a new line of desk-high systems from Flexible Computer Corp. attests. The Dallas company is targeting two new configurations of its Flex/32 Multicomputer—the Series 600 and 1200—at system integrators interested in embedding parallel processing into their processors. Both systems are housed in 21-in.-high cabinets, compared with Flexible's existing 6-ft-high Multicomputer. The company has lowered the price of an entry-level system—a two-computer 600 model costs less than $50,000, compared with a starting price of $150,000 for the Flex/32. ☐

WESTERN DIGITAL UNVEILS MEMORY PRODUCTS FOR IBM PC

Western Digital Corp., the Irvine, Calif., designer and manufacturer of disk-drive ICs and controller boards, is entering the retail market with four products aimed at users of IBM Corp. Personal Computers. To be introduced at Comdex/Fall '85 in Las Vegas, the products include FileCard, a 10-megabyte Winchester mounted on a pc board; PortaFile 20, a portable 20-megabyte Winchester; PortaFile 10SASI, a 10-megabyte portable Winchester with a Shugart Associates Systems Interface; and the WD60Ti, a 60-megabyte tape system. The peripherals will be sold to both original-equipment manufacturers and to retail outlets. Prices range from $1,095 to $1,295. ☐

PRIME PROGRAM TRANSFERS CAD DATA AUTOMATICALLY TO ALL DATA BASES

Prime Computer Inc. will close a gap in the computer-aided-manufacturing loop with a software product that automatically pulls data from computer-aided-design drawings and transfers it to all data-base management programs running on the system. For example, if a design needs additional material, that information will be transferred to the data base of a resource-planning application. To be introduced at Autofact '85 this week, the Management Decision runs with Prime's Medusa design-drafting software; it sells for $5,000 to $8,000, depending on the Prime system used, and will be available by January. ☐

RACAL-VADIC MODEM RUNS AT 9,600 BAUD FOR PERSONAL COMPUTERS

Racal-Vadic's proprietary communications protocol, which switches automatically between full and half duplex, enables its modem to blaze along at 9,600 baud for personal computers. Called the 9600VP, the Milpitas, Calif., company's modem operates at full duplex in the interactive portion of a communications exchange, then it switches to half duplex for transfer of long files. The modem also supports Bell 212A protocols for 300- and 1,200-baud transmission. The modem will be available this month for $1,495. ☐

Electronics

WILL U. S. FREE VHSIC CHIPS FOR NONMILITARY USE?

THE ANSWER COULD BE YES, AS PENTAGON STUDIES POSSIBILITY

LOS ANGELES

Competition to sell chips developed for the Pentagon's Very High-Speed Integrated Circuits program to military contractors is building fast. The latest entrant is TRW Inc., one of the six original Phase 1 VHSIC suppliers, which last week unveiled marketing plans and details on its 13-device signal-processing set. TRW thus joins Honeywell Inc. and IBM Corp. in the Phase 1 VHSIC sales arena. Texas Instruments Inc. is also ramping up its VHSIC fab line in Dallas and expects to be in volume production very shortly.

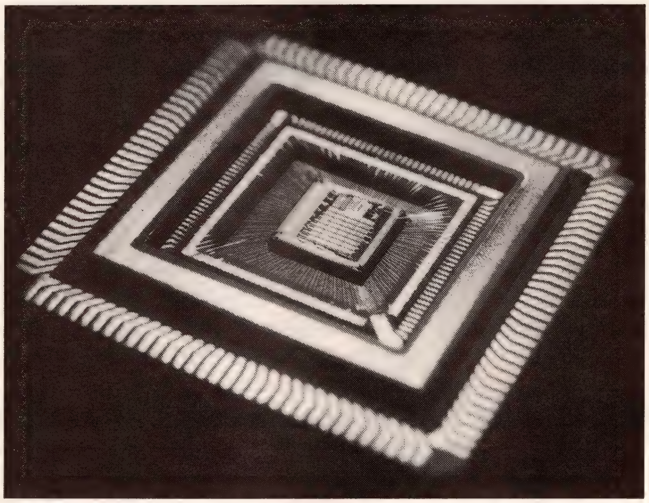
But the most significant VHSIC marketing event yet could be one that all contractors would welcome—getting a go-ahead from the Pentagon to sell the high-performance chips to selected nonmilitary customers, a market with far greater potential.

For the first time since the VHSIC program began early in the decade, there seems to be a real possibility that the Pentagon will approve sales of VHSIC chips to nonmilitary customers. No decision has been made by the Pentagon, but sources from the VHSIC contractors, who do not want to be identified, report that a committee inside the Department of Defense's VHSIC program office is studying this possibility. One source says the committee favors such commercial sales, because they would rapidly bring down unit prices to levels where their applications would be widespread. "It's a sure thing to happen—and sooner rather than later."

For a successful insertion phase, during which the VHSIC parts are used in new military-equipment designs, prices must drop by a factor of 10 from today's very expensive levels. Honeywell sells its samples for $6,000, for example, and TRW charges $5,000, although volume prices would be much lower.

Honeywell hopes to sell its Phase 1 chips to commercial customers, says Pat Narendra, director of digital-signal-processing products at the company's Solid State Electronics Division, Colorado Springs. To this end, he notes, Honeywell is involved in discussions with the DOD. Meanwhile, Honeywell is moving ahead with a plan to develop a line of advanced commercial chips based on 1-μm VHSIC process technology.

Making VHSIC chips available outside the defense community would unquestionably attract such customers as designers of graphics work stations, who would reap the benefits of high performance, observes market consultant Will Strauss, president of Forward Concepts, Tempe, Ariz. "For image manipulation, there is nothing remotely like them. If and when those 25-MHz chips hit the street, it will get very interesting."



FAST SWITCH. Among TRW's first VHSIC products to market is a 13,500-device matrix switch chip that can reset a switch in 40 ns.

But a barrier to selling VHSIC chips commercially is their protected status under the International Traffic in Arms Regulations. At present, VHSIC chips may be sold only to defense contractors qualified to receive ITAR materials. Potential commercial customers might not be able to pass muster, sources say.

Not all Pentagon officials have lined up behind the move to sell VHSIC chips commercially. The program's primary aim is to serve the needs of DOD contractors, says E. D. Maynard, director of the VHSIC program office. He is reluctant to endorse plans to market the chips commercially: "I don't think we perceive that as a necessary thing." The VHSIC office is, however, conducting an "ongoing examination" to determine how to manage VHSIC technology.

The processing technologies used in the VHSIC program are not restricted, Maynard says, but he still sees ITAR restrictions as a significant barrier to commercial applications. Has his office looked at ways of getting around the restrictions to speed commercial sales? Maynard says he has thought about it, but adds, "we're not the guys who put those restrictions on [VHSIC parts]."

TRW's chip set appeals to both commercial and military customers, because each chip is designed to perform generic digital signal processing. "Thus they can be configured and arrayed in different ways... to accomplish different tasks," says Thomas A. Zimmerman, manager of VHSIC programs.

Honeywell has been offering samples of its three-chip electro-optical signal-processing circuit sets to military customers since April. IBM's Federal Systems Division in Manassas, Va., was apparently the first Phase 1 contractor to supply evaluation parts to prospective customers. Without public announcement, the division offered to begin delivery of a six-chip set as early as the second half of 1984 [*ElectronicsWeek*, Nov. 19, 1984, p. 18]. Sales of the 13 TRW chips—three are available now and five more by the end of the year—will be handled through the VHSIC program office at its Electronic Systems Group in Redondo Beach, Calif.

The available chips are a 13,500-device matrix switch for programmable interconnections; a 66,329-device content-addressable memory; and a 42,000-device multiplier-accumulator. Scheduled to be available in December are a register arithmetic logic unit, a microcontroller, an address generator, a convolutional decoder, and a convolver. All the chips incorporate 1.25-μm or smaller feature sizes and operate at 25 MHz.

Each chip will be shipped with individual test results, and TRW will make design tools available. Among these are an instruction-set simulator for writing code for brassboard designs and a chip-boundary unit for simulating controls and gate delays. TRW has sold some samples, but contracts for production in volume are not expected before the middle of next year, because customers are moving carefully.

TI is ramping up production for seven of its eight Phase 1 chips. The microcode for one, a general buffer unit, is being reworked, and it is expected to be in production in January. "We are now going through a complete internal qualification and characterization before we start our volume deliveries," says Jesse Wilson, manager of the Advanced Microelectronics Division of TI's Defense Systems and Electronics Group.

TI is shipping samples of its n-MOS 72-K static random-access memory and a bipolar multipath switch chip. The bipolar data-processor unit, which executes the MIL-STD-1750A instruction set, is due to start sampling this week. TI has asked the DOD that it be allowed to sell the RAM chip to nonmilitary customers, but it expects its other chips to come under the terms of ITAR.

Market watchers do not know yet how big the market for VHSIC chips will be. "We didn't know VHSIC was coming this fast," admits Dean A. Winkelmann, who follows military semiconductors for Integrated Circuit Engineering Corp., a Scottsdale, Ariz., consulting company. He is still skeptical about whether VHSIC chips will move into a wider market "since I doubt the government will recognize its commercial possibilities." *–Larry Waller*

MILITARY

PENTAGON WANTS MORE RESCREENING OF CHIPS

WASHINGTON

The Defense Department is ready to present a new procurement policy that is likely to increase the chip rescreening required of defense contractors, but tight-lipped Pentagon officials say it is too early to predict how the policy will be implemented. While prime military contractors and their suppliers wonder how the policy will affect them, independent test houses are gearing up for the expected windfall business.

The cause of all this activity is a soon-to-be-published Pentagon manual designed to encourage prime contractors to rescreen 100% of the incoming microcircuits used in weapons systems. The primary impact of the new policy, which is based on a DOD directive issued last January, will be to shift responsibility for quality assurance from chip makers to system houses.

The manual shows prime contractors how to control chip defects the DOD says are coming in at 3% to 12%. The Pentagon hopes to reduce that figure to less than 1%. Though industry observers say rescreening could hike the cost of integrated circuits and discrete semiconductors by 30% to 40%, the Pentagon argues the extra step will pay for itself because the cost of fixing defects grows by a factor of more than 10,000 when a system gets into the field.

"They want to ensure that they are getting what they are paying for and what is specified," explains Eugene R. Hnatek, manager of research and development engineering at Viking Laboratories Inc. The Mountain View, Calif., subsidiary of Honeywell Inc. is one of several testing houses that screens parts for defense contractors. Echoing the sentiments of other observers, Hnatek says rescreening "has to be done on a case-by-case [basis], such as if you have a sensitive device type or a manufacturer that has been out of control."

The Navy has required rescreening for the past three years, and the Army has been moving in that direction. Critical applications such as the Army's multiple-launch rocket system will determine its rescreening requirements, says Seymour J. Lorber, the Army's director of quality assurance. "You handle each case on its merits." But, Lorber adds, the Army will deny requests by contractors for waivers on programs requiring rescreening.

The Air Force, which is tightening up microelectronics specifications set by its Defense Electronics Supply Center, is also expected to move toward more rescreening. But "we haven't formulated our strategy yet," says Edmund J. Westcott, a product-assurance official with the Air Force Systems Command.

CASE BY CASE. Rescreening "probably will never be a requirement in all contracts," says Richard A. Stimson, director of the Pentagon's Industrial Productivity Office. The DOD wants to encourage the use of incoming inspection, but the decision to invoke it is a "contract-by-contract decision," he continues. "Theoretically, you get to a point where you don't have to screen."

The rescreening plan was favorably received by defense contractors at a recent meeting on standards and quality assurance, notes Eli Lesser, one of Stimson's assistants.

"We support it," says Mike Cooney, quality and reliability assurance manager for Texas Instruments Inc.'s Defense Systems & Electronics Group in Dallas. "We feel very strongly an original-equipment manufacturer should have the option to use it where it makes good business sense. And we must have the data to back up those choices."

An official who requested anonymity says that his company's voluntary rescreening experience demonstrated that such programs could indeed reduce production costs for prime contractors when they are hit with the recurring problem of chip makers not conforming to Pentagon specifications. Over a period of several years, the company was able to reduce in-production line-failure rates by better than a factor of 10, he says.

Though some defense contractors view rescreening favorably, suppliers of military semiconductors clearly do not. "I'm flabbergasted that they would put

A BOOM FOR TEST LABS IN RESCREENING

The expected growth of military semiconductor-rescreening requirements is attracting the attention of independent testing laboratories such as Environmental Processing Inc. of Richardson, Texas. Five-year-old EPI, which had revenues of $18.5 million last year, sees an overall market potential of $500 million from new rescreening requirements over the next five years, says Michael S. Fisher, director of sales and marketing.

That potential has the testing house gearing up for what it believes will be a sudden flood of business in the coming months as prime defense contractors scramble to meet incoming testing clauses in new contracts for 1986 deliveries. "I had a meeting with a major contractor this past year to talk about rescreening requirements in one of its programs. The program manager said that was the 'stupidest requirement I have ever heard of, and we'll never have to do that,'" recalls Fisher. "The guy called me back a month ago and said he was told by the Navy he must."

Fisher says the typical rescreening process includes electrical testing at 25°, 125°, and –25°C, particle-impact noise detection, temperature cycling, destructive physical analysis, constant acceleration, burn-in, fine- and gross-leak testing, and radiographic and external visual inspection. *–J. Robert Lineback* out a directive like that," says Edward Macaruso, military sales manager at Signetics Corp. in Sacramento, Calif. He advocates a policy of preventing defects during fabrication rather than detection at the system house, adding, "to me, a rescreen is a Band-Aid." Chip makers, who do their own 100% rescreening, complain that systems makers damage good parts through careless handling.

Another prime contractor, Westinghouse Electric Corp., has been operating a full-scale rescreening facility since 1983. Westinghouse's Material Acquisition Center, near Baltimore, now tests 90% of incoming ICs and has lowered reject rates to 1.5% from 4%. Westinghouse plans to begin 100% inspection of ICs in the next few months. *–George Leopold and J. Robert Lineback*

MILITARY EXPERT SYSTEM WILL GENERATE ADA CODE

HAWTHORNE, CALIF.

Northrop Corp. is beginning development of an expert system that will generate critical real-time avionics software for use on tactical military aircraft. The real-time software will be coded in Ada, the language mandated by the Defense Department for use in military systems, rather than in Lisp, the language used by most existing expert systems.

As with other expert systems, the starting point and focus of the current effort is to develop a set of unified tools, in this case called the Ada expert-system environment. With these tools, expert systems can be produced, which in turn will be used to generate the Ada-coded real-time software that will run on avionics processors.

The project also seeks to evaluate how well Ada and the Air Force MIL-STD-1750A computer instruction set meet the real-time needs of avionics and tactical weapons systems, points out Marilyn Aglubat, lead engineer for the Artificial Intelligence Research and Development Group within the Avionics Engineering Department at Northrop's Aircraft Division in Hawthorne, Calif. The Ada expert-system project builds on Northrop's work on its Estas, or Expert System for Target Attack Sequencing, which advises pilots on navigation, threat avoidance, and weapon firing.

The project, which is being financed with internal research and development funds, should have an initial prototype ready in mid-1986, when it will undergo evaluation at Northrop's flight-simulation laboratory. The system will produce Ada code that can be run on processors that execute 1750A code, a standard used on many tactical military aircraft.

Science Applications International Corp., La Jolla, Calif., will perform Northrop's conceptual design work under a just-let contract that's reportedly worth several hundred thousand dollars. The system will contain a generic shell, into which domain-specific knowledge can be placed later, says Michael Donnell, an assistant vice president at Science Applications. "The forms of knowledge representation and inferencing that are allowed within the context of the shell would tailor it particularly toward applications in the avionics domain," he says. Northrop's in-house Ada compiler, which is currently undergoing Defense Department validation, will be used.

The Estas AI project is due to appear as a prototype system in December. Estas, which is being implemented in Lisp on Symbolics Inc. hardware, was developed jointly by Northrop and Science Applications with Northrop funding. "Estas looks at the final attack phase of an air-to-ground mission," says Donnell.

Information from an aircraft in flight will be downloaded to Estas, which will maintain data about targets and obstacles such as enemy antiaircraft batteries. If an aircraft is diverted—by enemy fire, say—Estas will calculate a new flight plan. When the aircraft reaches the target area, Estas will suggest priorities for targets, determining the most efficient allocation of the aircraft's weapons to the various targets.

Northrop got started in AI only recently, under the banner of a program called Infusion of AI into Aircraft Systems, says Aglubat. "The idea is to progressively learn about the technology and build a knowledge base from which we can understand applicable AI techniques and concepts," she says.

Both Estas and the Ada expert-system environment may be applicable to a number of Northrop programs. Most notable is the Pilots Associate Program, government-funded project to determine how expert systems can improve mission effectiveness and combat survivability. *–Alexander Wolfe*

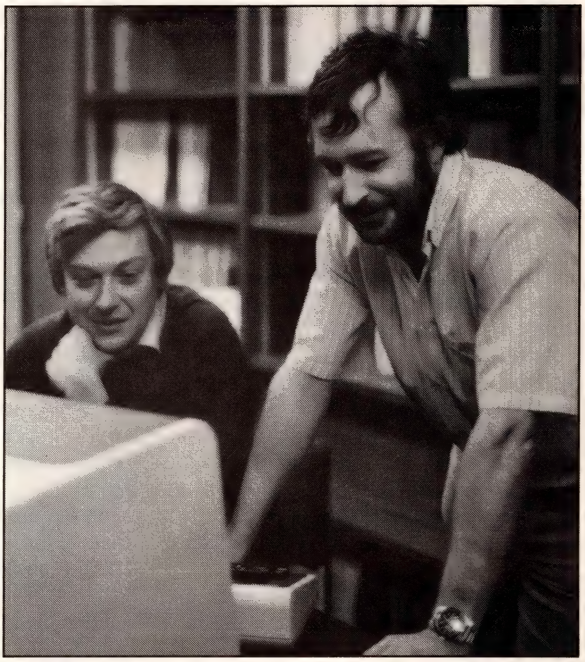
MICROPROCESSORS

THOMSON PURSUES 70-BIT ADDRESSING SCHEME

PARIS

France's flagship integrated-circuit maker is laying a heavy bet that equipment manufacturers will need a radical new generation of microprocessors to support the high-end data-processing applications of the 1990s. Since 1982, a long-secret project has engaged 40 of Thomson's top engineers—25 defining system architecture at the company's Central Research Laboratory in Corbeville and 15 working out the technology at Thomson Semiconducteurs' MOS-production facility in Grenoble.

The project, called SCQM—a code name with a meaning the company will not reveal—is aimed at designing a seven-chip set that can address an enormous virtual space by using an object-oriented instruction and addressing scheme. "Equipment manufacturers generally upgrade their products by using ever more powerful versions of the same microprocessors in an effort to retain compatibility," says Michel Robin, Thomson's planning director. "As we see it, a rupture of this process will be inevitable when micro-



HEADS TOGETHER. Jacques Leroudier (right) consults with colleague Alain Kurinckx on the design of Thomson's SCQM.

processors based on standard architecture are inherently incapable of handling sufficiently large amounts of highly structured information necessary for many future applications."

LARGE CATEGORY. Jacques Leroudier, who leads the company's system-architecture design team, points out that air-traffic control, computer-aided design, military systems, industrial distributed-control systems, and other decision-making systems will fall into this category.

One difference between these applications and those now served by standard microprocessors is the need to manipulate sufficient memory to deal with "stored" models, where a central processing unit satisfies data requirements by consulting, say, the coordinates of a matrix. Standard microprocessor systems favor computed models, where the CPU executes a known algorithm.

To meet the expected requirements, Thomson researchers use a reduced-instruction-set-computer CPU that can operate in a fully transparent multiprocessor environment. Its operating speed could exceed the equivalent of 30 million instructions per second of a complex-instruction-set computer.

In the SCQM architecture, the memory is a single virtual space addressed with 70-bit virtual addresses. Within this space, data takes the form of objects—segments of memory accessed only by means of a "key," which is a series of bits included in the virtual address and issued only to the creator of an object at the moment the person creates it. This ensures data security, because an object can be accessed only by the key or a duplicate issued by the creator.

The 70-bit virtual address defines an object, which is issued by system hardware, and serves as a permanent identification number for an object. Once used, a virtual address is never reused, even if the object is destroyed. To access data, associative registers in the SCQM's CPU translate the 70-bit virtual addresses into 32-bit physical addresses.

An SCQM machine consists of several nodes connected by a dedicated network. Each node, or cluster, can address up to 4 gigabytes of main system memory and is made up of from 1 to 16 SCQM basic modules. Each of these modules is based on the system's seven ICs: the CPU with a 64-bit bus and 32-bit arithmetic logic unit, a mass-memory controller, an 8-K-byte cache-memory module, a cache-memory directory, a bus controller, a bus arbiter, a controller for main memory, and an interface circuit to connect the SCQM to a peripheral bus. System software will be an operating system compatible with AT&T Bell Laboratories' Unix and Ada run-time support.

In its prototype version, the SCQM's peripheral bus will follow the VMEbus standard, and an Ethernet bus will connect the clusters. Leroudier says the use of other buses would cause no fundamental problems.

The total number of SCQM clusters that can be connected in a given system is a function of the speed of the bus used to connect them. Using an Ethernet bus, the figure ranges from 30 to 100 nodes. A 1-gigabit optical-fiber network, when such technology becomes available, will offer the option of connecting up to 1,000 nodes.

Technology for the SCQM prototypes will be a CMOS 1.2-μm process with three interconnection levels—one polysilicon, two metal. The industrial version will be reduced to 0.8 μm in an effort to keep the chip sizes smaller than 50 mm^2. The propagation delay will be 0.5 ns.

Thomson declines to give a deadline for introduction of the SCQM, though Robin confirms that the first prototype chip—the 650,000-transistor cache memory—will be produced during 1986. The SCQM is being considered for a joint development project under the European Eureka program that teams Thomson with Siemens, Philips, and the UK's General Electric Co. *–Robert T. Gallagher*

NATIONAL DEFENDS LEAD IN 32-BIT COMPUTER CHIPS

SANTA CLARA, CALIF.

The 32-bit microprocessor battle became the October war with no less than four companies unveiling new offensives last month. Rounding out the action was National Semiconductor Corp.'s announcement at its annual meeting that it is offering samples of its second-generation product, the 32332. National claims the chip is three times faster than the first 32-bit part on the commercial market, its two-year-old 32032.

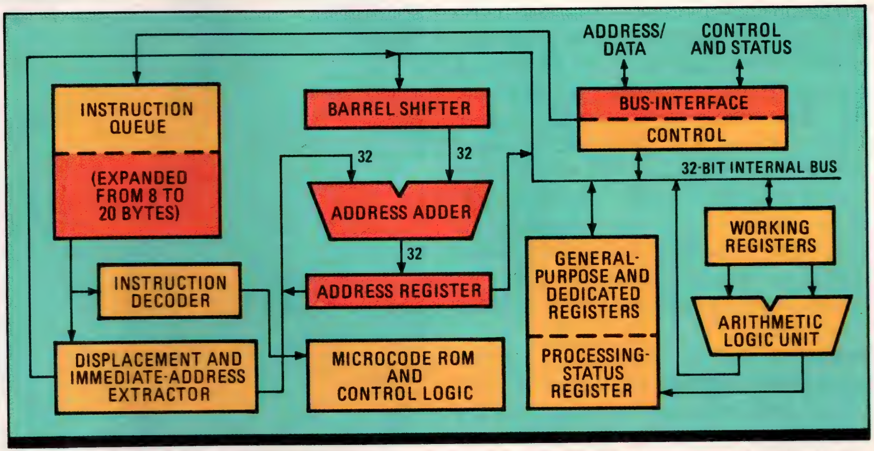
National joins three others with new 32-bit parts

National's introduction follows the October announcements by Fairchild Camera & Instrument Corp. of its Clipper chip set, including a 32-bit microprocessor that will operate at 33 MHz; by England's Inmos Ltd. of its 32-bit transputer, a chip for parallel-processor designs; and by Intel Corp. of the long-awaited 80386, a 32-bit upgrade of the 80286, whose architecture dominates the 16-bit market. With its new processor, which is scheduled to go into volume production before April, National should be able to stay in the mainstream, though it probably will see its market share erode.

As expected, the 32332 builds on the 32032 architecture, but is built in XMOS, National's 2.8-μm n-MOS process [*ElectronicsWeek*, June 3, 1985, p. 50], to hit clock rates up to 15 MHz. The company has added a new bus interface that allows dynamic bus sizing (for use with 8-, 16-, or 32-bit data buses), a barrel shifter, burst memory accessing, error and retry support, and an enhanced slave-processor communication protocol.

The new processor also has 32-bit addressing, allowing it to address up to 4 gigabytes of memory, and has on-chip support for a cache memory. Thus improved, the 32332 is cited as capable of about 3 million instructions per second.

And to add potential speed to systems based on its processor, National signed a pact with Weitek Corp. of Sunnyvale, Calif., to develop an interface chip, the NS32310, to link the 32000 family and Weitek's 64-bit floating-point chip set, which performs up to 4 million floating-point operations per second. Weitek has



ENHANCED. National's 32332 32-bit microprocessor triples performance and adds to the 32032's basic design in addressing and bus-control areas. New circuitry is shaded orange.

a similar arrangement with Intel Corp.

Positioning itself against Intel, also of Santa Clara, National executives point out that the 32332's VAX-like architecture already runs AT&T Co.'s Unix System V. Intel's 80386 currently runs only Xenix, Microsoft Corp.'s implementation of Unix, with System V capability still to come. In addition, the 332 supports demand-paged virtual memory, whereas the 80386, showing signs of its family's 16-bit past, uses segmentation techniques for managing its virtual memory. National has no on-chip memory-management unit, and the company says that nets it a cost advantage. The 32332 is sampling now for $195 apiece, compared with the 386's $295 tag.

Intel's supposed advantage of a huge software base developed for its 16-bit line is discounted by National's John T. Ferrick, director of strategic marketing for the 32000 series. "The market doesn't want to run existing software faster," he says, maintaining that the 32-bit market will be driven by a demand for new 32-bit applications.

SYMMETRY. As to raw performance, Intel quotes the 80386 as executing at 3 to 4 mips, and National claims no more than 3 mips for the 32332. But the 332's throughput is greater for two reasons, Ferrick claims. First, the use of general-purpose registers makes for a more symmetrical, hence more efficient, instruction set. Second, National's code efficiency is greater than Intel's when a high-level-language compiler is used.

Despite all the announcements, "the outlook for the market has not changed," says Mel Thomsen, a senior industry analyst with Dataquest Corp., San Jose, Calif. Currently, National, with 1,500 design-ins for its 32000 family, has a large share of the small ($17 million) market forecast for this year. "It will be 1988 or 1989 before anything that's started today turns into a volume product," he says. Therefore, he believes "any one of the companies in the market now stands a good chance to be a market leader."

The advantage Thomsen sees for National is its 32000-family second-sourcing agreement with Texas Instruments, calling it "the strongest marketing alliance that exists right now." On the other hand, industry sources indicated last week that TI was negotiating with AT&T for the right to second-source the communications giant's 32-bit WE32100 microprocessor as well.

Thomsen does not say that the availability of these products will alter his company's forecasts, but he allows that the string of announcements may warm up the market because "designers can sit down and say 'Now I've got some choices.'" *–Eve Bennett*

MEMORIES

LAB DESIGNS SELF-TESTING RAM

ANN ARBOR, MICH.

Researchers at the University of Michigan have come up with a technique that takes advantage of the parallelism found on typical commercial memory chips to produce a design for a self-testing random-access memory. This technique can sharply reduce the amount of time required to test RAMs.

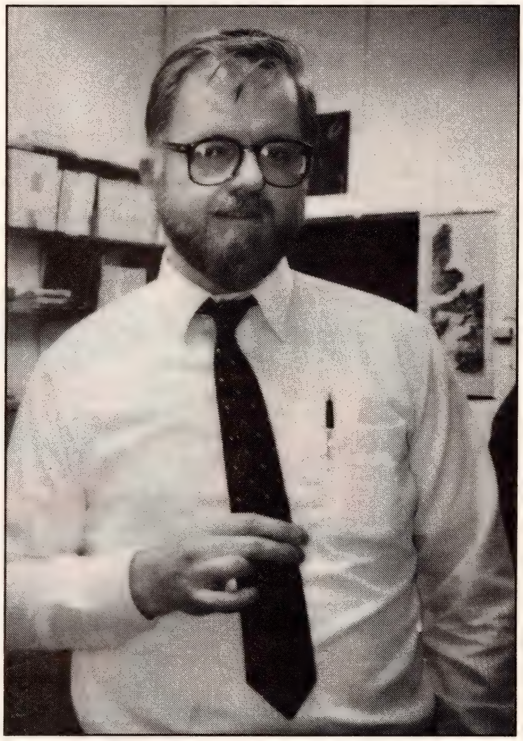
"We're trying to get faster coverage that doesn't sacrifice fault coverage," says John P. Hayes, the University of Michigan professor of electrical engineering and computer science who came up with the idea.

He has simulated the 4-K self-testing RAM design and hopes to obtain working silicon versions soon through the MOS Implementation Service (MOSIS) sponsored by the Defense Department's Advanced Research Projects Agency and the National Science Foundation.

The on-chip approach promises to reduce the test time for a 1-Mb RAM with close to 100% fault coverage to about 1 second, Hayes contends. By contrast, the same dense device would require several days to test with external memory testers employing the widely used Galpat test, for example, and fault coverage would not be as complete, he says. The university has applied for a patent on the technique and hopes to license it for use by commercial memory manufacturers.

PARTITION TESTS. Commercial memories are typically laid out in a series of from two to eight arrays of identical storage cells, Hayes says. His technique uses test sequences that are generated on chip and run through each of the partitions simultaneously. The results of the partition tests are then compared with on-chip verification circuitry.

The test sequences are generated by simple logic circuitry that is built around the partition periphery. This circuitry works in conjunction with the chip's refresh logic and sense-amplifier arrays to pump test-data sequences through each column of cells in a partition. Each column becomes a serial shift register from which results are read out using the chip's own sense amplifiers. Thus the technique reduces the test time, not only by testing each of the partitions in parallel and comparing the results but also by testing each column of cells in each partition simultaneously, Hayes says.



PROTOTYPES DUE. Hayes hopes soon to have working silicon versions of his self-testing RAM design.

Using the technique on a commercial RAM would require the addition of test-generation and -comparison logic, in addition to minor modification to the sense amplifiers and column address decoder. Some peripheral circuitry would also have to be duplicated. In all, Hayes says that the additional circuitry will increase chip size by about 12% on a 4-K RAM designed recently by Hayes and University of Michigan graduate student Younggap You.

But as memory density increases, the circuit overhead goes down, Hayes points out. He estimates that the self-testing circuitry would take up only about 5% of chip real estate for a typical 1-Mb RAM design.

The University of Michigan has contacted memory manufacturers about potential licensing of the technique, but has as yet had no takers, says Robert Gavin, an attorney at the school's Office of General Counsel who is overseeing the effort. But, Gavin says, "Once we get working prototypes, I think we'll really be able to generate some interest." *–Wesley R. Iversen*

INDUSTRIAL

CAN FACTORY SYSTEMS CURE APOLLO'S SLUMP?

CHELMSFORD, MASS.

The first demonstration of an integrated design-to-production manufacturing system based completely on work-station platforms is likely to attract much interest at Autofact '85 in Detroit this week. Apollo Computers Inc., the demonstration's organizer, will pull together 13 software vendors and three factory-automation hardware vendors to close the loop for the design and fabrication of robot-gripper parts.

Faced with stiffer competition in the work-station market and coming out of a red-ink quarter, Apollo is anxious to prove it offers the complete solutions touted by its competitors. Most observers concede the technical superiority of Apollo's networking technology over its competition, but they say a successful move into computer-integrated manufacturing, computer-aided design and -engineering, and other areas where software value can be added is essential if Apollo is to remain a major player.

The Autofact demonstration ties 19 work stations and a computation server with machine tools and a robot. Autofact also is the site of similar demonstrations of the MAP factory-communications protocol (see story, p. 55).

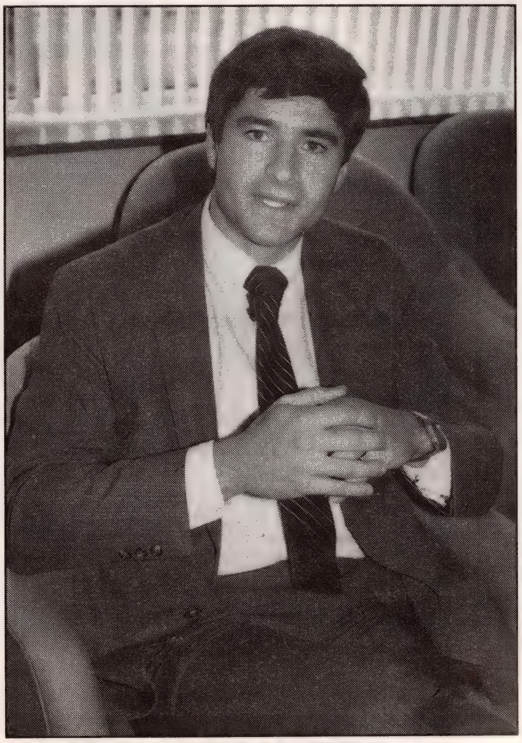
Apollo emphasizes the use of standards in moving data among the applications on its Domain network and that the data-sharing ability provided by the network can streamline production. Communications rely primarily on the International Graphics Exchange Standard (IGES) and on ASCII data sharing.

The demonstration begins with the creation of a project-management plan and moves through design, analysis, and simulation. Data then goes to a numerical-control package, where it is processed before going to a machine that cuts the gripper fingers, intended for use in printed-circuit-board assembly. Also running are scanning, technical publishing, shop-floor control, and machinability packages, among others.

Demonstration at Autofact links diverse software

Data sharing is the key to speeding production, in Apollo's view. "In the past, all the communication among different departments was passing pieces of paper around. That was extremely cumbersome and led to errors," points out Ronald Gentile, manager of Apollo's CAE and mechanical-CAD segment.

For example, a solid model created using GE CAE International Inc.'s application package on an Apollo DN 660 work station can be accessed in IGES format by MacNeal-Schwendler Corp.'s analysis programs on another station. A user can run a solids-modeling program in one window of a station and access files in another.



MIX MASTER. Apollo's Beaudin says mixing and matching software is needed to support manufacturing tasks.

Apollo's biggest challenge was getting all the software vendors to plug into the effort. "The reality is that no one can support the full breadth of CIM applications," says Richard Beaudin, Apollo's manager of factory automation. "The only way to support it is by mixing and matching."

By the same token, Beaudin says Apollo sees the necessity of tying in with other hardware by offering links to IBM Corp.'s Systems Network Architecture and Ethernet, as well as Digital Equipment Corp.'s VAX line.

Apollo pioneered the work-station market and achieved revenues of over $200 million in just five years. In recent months, however, questions have been raised about the company's future growth, despite revenues that for the first nine months of the year are up 60% over the same period last year. In the last quarter, on the other hand, Apollo reported an operating loss of $4 million and wrote down $14 million in inventory.

The company has been hurt by its relatively late entry into the market for work stations running on AT&T Bell Laboratories' Unix. It is now pressed by the economic slowdown and strong new competition from DEC's MicroVax II. Another threat looms in the guise of IBM's entry into the work-station market, expected before the end of the year.

As primarily a hardware vendor, Apollo is in what is becoming a commodity market, says Vicki Brown, senior analyst at International Data Corp., Framingham, Mass. Success thus depends more on high-volume production than on technology.

Apollo is unlikely to find that volume in the current market. Brown predicts that the compound growth rate for the mechanical-CAD market will be –4% from now through 1990 because of falling hardware prices. The CIM market has high-volume potential for Apollo, says Brown, and might let it broaden its user base, which has been dominated by a few large customers.

Finally, CIM offers Apollo the opportunity to increase the software content of its products. "They must get their software content up... to maintain their margin," says Craig Symons, a financial analyst with G. G. Advisory Services, a subsidiary of the Gartner Group in Stamford, Conn. *–Craig D. Rose*

OPTICAL STORAGE

DU PONT, PHILIPS POOL DISK ASSETS

NEW YORK

Du Pont and Philips are so sure optical disks will boom in the near future that they have teamed up to form what they claim will be the largest optical-disk manufacturer in the world.

At joint press conferences in New York and London last week, the corporate giants said they were merging all their optical-disk operations and assets into a joint venture for the development, manufacture, and sale of disks for audio, video, and data. When the as-yet-unnamed company begins operation in January, it will already be the world's largest maker of audio Compact Discs. Its assets are quoted at $150 million.

Under the agreement, which has not yet been finalized, NV Philips of the Netherlands will contribute its CD patents; its Polygram recording subsidiary's CD manufacturing plant in Hano-

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CLEAN COAT. A worker in a clean room at du Pont's development laboratory near Wilmington, Del., is about to apply a protective coating to a 14-in. optical data-storage disk.

ver, West Germany; its plant in Blackburn, England; and related facilities in Eindhoven, the Netherlands. The Hanover plant is currently the world's largest CD-manufacturing facility, says C. Lo Rinck, managing director of the NV Philips Subsystems and Peripherals Group. Annual capacity is now estimated at 25 million disks, and Rinck said that will be boosted to 40 million to 45 million in 1986. The Blackburn site produces data disks as well as 12-in. video disks for Philips's LaserVision system; the Eindhoven site houses development labs for audio and data disks.

E. I. du Pont de Nemours & Co. will contribute an optical-disk facility near its Wilmington, Del., headquarters that produces 14-in. high-density data disks, "plus its materials technology, U. S. market presence," and a substantial undisclosed amount of cash, says Michael Hartnagel, director of the Storage Products Division in du Pont's Photosystems and Electronic Products Department.

The venture also has taken an option on a building in King's Mountain, N. C., which will become a manufacturing plant with a capacity of 25 million disks per year by the end of 1987, and up to 50 million per year in 1988. Combined, the facilities should have a capacity of 200 million disks of all kinds per year by 1990, says du Pont vice chairman Edgar S. Woolard Jr.

The venture, Woolard says, will develop and market read-only disks, write-once programmable ROM, and eventually erasable disks. Erasable disks, he says, will use either Philips's magneto-optic or phase-change technologies in conjunction with chemical technologies developed at du Pont for the disks' substrates and coatings.

CHEMISTRY. "There are two technologies at work here," says John Abbink, vice president of the International Research Department at Merrill Lynch & Co., New York. "The technology in the product itself, which Philips invented, and then the technology in figuring out how to do it economically. That's the hard part, the chemistry. It's going to be very gradual growth—assuming that erasable technology works and is not too expensive. Magnetic disks will almost certainly always be cheaper."

The two companies operate a second joint-venture company, PD Magnetics, which makes chromium dioxide magnetic tape in the Netherlands. Hartnagel says both ventures eventually will be run by the same governing board of du Pont and Philips executives.

Rinck predicts sales levels of $120 million in 1986 and $500 million in 1990. Such predictions, Abbink says, are "a bit optimistic, but probably close to the mark." *–Tobias Naegele*

COMPANIES

WHY THOMSON-CSF WANTS MOSTEK

PARIS

Thomson-CSF long has had it in mind to set up shop in a big way in the U. S. semiconductor market. Now it could wind up in the chips in Texas as the new owner of Mostek Corp.

During talks last week with United Technologies Corp., parent company of the Carrollton chip maker, Thomson president Alain Gomez expressed confidence about his bid to buy all the U. S.-based assets of Mostek—including manufacturing facilities, product line, and sales force—at a bargain price. Sources say the French bid was substantially less than the $75 million the Hartford, Conn., conglomerate wants.

Thomson hopes to wrap up the deal by mid-November. But some industry people think it might be better for Thomson if Gomez didn't succeed. Mostek, they say, would be a financial drain on Thomson, whose semiconductor operations are in the red. In addition, Thomson, whose offer is contingent on getting the services of Mostek president James R. Fiebiger, might be unable to retain key managers. Thomson's acquisition of Mostek "would be another sinkhole for another foreign manufacturer," thinks James L. Barlage, a vice president of Smith Barney, Harris, Upham & Co., New York.

Competitors label Thomson's Mostek bid a 'recipe for disaster'

For Thomson, the attraction of Mostek is twofold. Its executives are convinced their goal of boosting chip sales to $1 billion by 1990 is largely dependent on building a strong presence in the U. S. The company had already decided to establish a MOS production facility in the U. S., so United Technologies' decision to shutter Mostek presented Thomson with a target of opportunity.

"There is simply no way that you can be a major player in the U. S. [chip market] without producing there," declares one Thomson executive. "We've already substantially expanded our sales presence in the States, but that's no substitute for having a front-end plant. With all of the design and development support required for an activity like that, you automatically have the critical mass of local competence you need to gain the confidence of customers. It also makes it infinitely easier to recruit quality personnel."

Thomson Semiconducteurs president Jacques Noels is convinced too that his company will be able to compete technologically only if it can be a leader in the dynamic random-access-memory market. At the moment, Thomson is making small quantities of 64-K parts at its plant near Aix-en-Provence, using masks acquired through a deal with Japan's Oki Electric Industry Co. Buying Mostek, whose principal business is memories, would catapult Thomson into the midst of what it considers a business of strategic importance.

Despite Thomson's positive feeling about the takeover, some components executives are less convinced. "Talk about a recipe for catastrophe, this is it," says one of Thomson's European competitors. "In the middle of the worst crisis in the history of the industry, a company that is, granted, improving, but still bleeding red ink, buys the basket case of the business. They'll need a lot more than luck to make a go of it."

Thomson executives discount such pessimism, saying they don't plan simply to try reviving Mostek. Their objective, they say, is to use Mostek's assets as a way of hitting the ground running with their own strategy in the U. S. "Risky? Sure it's risky," says one company source. "Do you really think we're going to get into the top 10 without taking risks?" *–Robert T. Gallagher*

PACKAGING

3M OPENS LAB TO BOOST TAPE AUTOMATED BONDING

AUSTIN, TEXAS

Executives at 3M Co. hope to encourage a move to volume usage of tape automated bonding by picking up the tab on TAB experimentation in the company's new Austin laboratory.

Chip makers and many computer houses are willing to try reels of low-lead-count chips that have been automatically mass-bonded to special insulating tapes, but few are spending money to evaluate the process for chips with high lead counts. Managers at the recently relocated 3M Co. Electronic Products Division say that the company's 1,200-ft^2 applications lab will play a key role in boosting high-volume usage of TAB in the industry by 1987.

"Most of our major customers are still in the experimental stage, and it is a time when you have to be synched in with them and work along with them," notes Dennis J. Enright, the division's vice president. In addition to giving interested companies hands-on experience with TAB, 3M officials hope to gain valuable information about the needs of an emerging tape market for high-lead-count devices. Even TAB assembly-equipment suppliers with systems in the 3M lab are looking for feedback from users and from the facility.

So this month, 3M begins selling new TAB bonding kits that contain all the pieces necessary to evaluate the technology's potential. The kits, which start at $4,250, will support lead counts as high as 328. Kits include gold or tin tape for 250 chip sites. Companies that buy the kits can use the lab free of charge.

Lab managers say evaluation teams from interested companies will average about two days in the lab per visit, and 3M plans to accommodate about two companies a week. The TAB facility, which 3M officials say would cost a potential customer $300,000 to $500,000 to duplicate, is loaded with production-class equipment, including an inner-lead bonder from Jade, an outer-lead bonder from Farco, wafer-mounting and dicing systems from Disco, an infrared furnace from Radiant Technology, test equipment, and inspection stations.

The 3M facility also has a Calma Co. design-automation system for TAB lead routing. The system can turn out a finished design in as little as one day, with an average turnaround time of about two weeks for production-ready masks. In addition, 3M has installed a fast-turnaround prototyping line, which will provide custom tape designs within three weeks of mask completion.

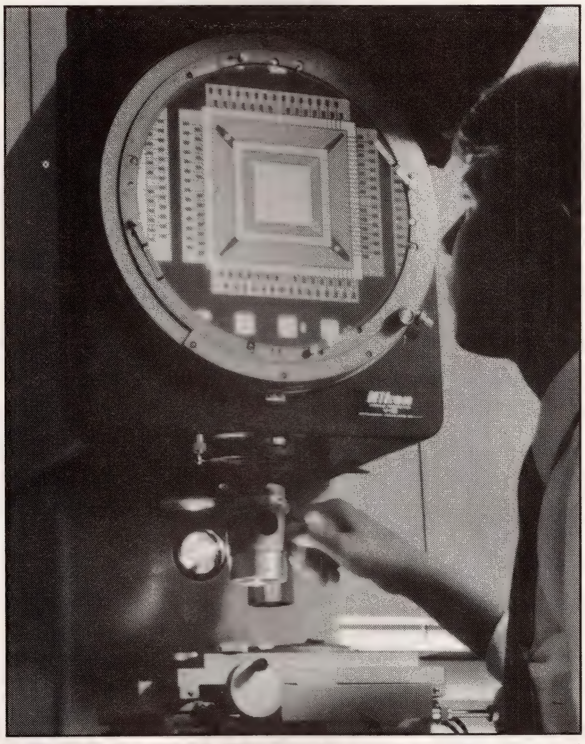
Officials at 3M—which has been supplying reels of tape-bonded chips for low-lead-count commodity chips since 1972—hope the Austin lab will give new high-lead-count applications the extra shove they need to reach volume usage. Industry analyst William I. Strauss of Forward Concepts, Tempe, Ariz., has been following the TAB movement for years and believes 3M's aggressive push into high-lead count products "could be enough to push the technology over the edge for volume business." In addition, Strauss notes, "IBM has been very up front, saying it considers TAB to be the technology of the future... They have even formed an internal procurement group for TAB. Digitial Equipment Corp. also plans to have TAB in two years at plants in Massachusetts and Scotland, although they are not saying which computer systems will be using outer-lead bonding of chips."

POTENTIALLY FASTER. "It is now clear that TAB is going to take off, but not in the sense that everyone once thought," adds Strauss, referring to earlier expectations that TAB would be used by chip makers for interconnection of low-lead-count commodity ICs. Since the late 1960s, TAB has been used by a number of semiconductor makers for inner-lead bonding of chips to lead frames of dual in-line packages. TAB assembly is potentially faster because it replaces the need to individually wire bond interconnections. Die interconnections are "gang bonded" from a beam tape that contains minute conductive traces.

The flat traces have lower inductance than the round wire. TAB connections can also be routed for shorter leads and to keep all the leads about the same length. Tightly packed tape-lead interconnections are more suitable for the new high-speed high-pin-count devices.

What's more, TAB traces have proven stronger than gold-ball soldered wire bonds to the flat surfaces of chips. And TAB-mounted chips can be placed directly onto printed-circuit boards, opening up higher board densities than conventional surface-mounted packages do and lowering the cost of volume assembly through automation.

Another company that has been offering capabilities similar to those of 3M's lab for about three years is Mesa Technologies, a Mountain View, Calif., subsidiary of Olin Corp. Mesa's application facilities are used for doing feasibility studies for prospective customers, including development of custom tape prototypes. *–J. Robert Lineback*



SEEING IS BELIEVING. This visual-inspection station is part of a large assortment of TAB equipment at 3M's new Austin lab.

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Robots get Smart in Japan
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February

Europe's Esprit Finally Sets Sail
LSI Logic Counts on Sandfort to make its Mark in Europe
Upstart Vendor Makes Waves in Japan's Robot Market
NEC Fashions New Fab Process
Olivetti's Viti Directs ET Designs that Marry Bus & Art
German Startup's Success Surprises Europeans
Britons Seek Tolerant Chips
OBI Rains on IBM's Parade
Mega's Friedrich Aims to Cut Asian Lead in Memories

March

British GaAs Chips Go to Market
NEC's CPU Leapfrogs IBM
Hitachi CPU Challenges IBM
France's Lansat Rival Set for Fall Launch
Olivetti Stakes Claim in Video Typewriters
Italian VLSI Chip has the Right Accent
Koreans Try for VCR Replay
Germans Push X-ray Exposure
There's Life in Resistors, German Company Finds
UK Beats a Path for Europe's Race

April

German System Meets New ICAO Standard
West Germans Squabble Over Choice of IFF
Britain Promotes Open Architecture
US Makes Progress in Japan Telecom Talks
Japan's Lead in Optical Disks: It's Part of the System
Daisenberger Guides US Firms through Red Tape
Asia: It's No Longer Just Japan That Threatens US Markets
Malaysia: Top Shipper of Discretes
Indonesia: Domestic Sales are the Lure

May

Thomson's VCR System Clears Up Doubts
ICL Banks on Networks and Japanese Chips
Min Blazes Bright Path for Korea's Gold Star
Asia: The Four Dragons Rush to Play Catch-up Game
Singapore Casts Lot with Software
Philips' Eurom Chip Finally Debuts
Sagging Prices Sting Japanese Producers
British Telecom Spreads Its Wings with Mitel
South Korean IC Maker Seeks World Markets

June

Plessey Switches Off Flash ADC, Saves Power
Sony Campaigns Hard for BMM Camcorders
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INSIDE TECHNOLOGY

BRINGING ORDER OUT OF CHAOS IN SOFTWARE DESIGN

AI MAY OFFER BEST HOPE FOR DEALING WITH GROWING COMPLEXITIES

by Alexander Wolfe

Today's engineers need more help than ever to navigate their way through increasingly large and complex software-development projects. But relief is on the way in the form of modern software-development tools that promise to bring an efficient development environment to designers who have long struggled with printouts and patches. These tools—which include a host of design methodologies—are turning chaos into order and improving productivity and should provide a more streamlined development process.

Forward-looking tool developers are working with artificial-intelligence and graphics techniques to enhance tomorrow's software-engineering environment. Structured design, advanced by proponents of the Yourdon design methodology and of program-design languages, is already becoming a necessity for serious software developers. Structured design creates software consisting of separate modules with well-defined interfaces; the individual modules incorporate top-down programming techniques.

On the marketing side, users have better access to products as bigger companies enter cooperative marketing agreements with smaller software-tool makers. And in the business world, software tools are turning end users into budding developers of applications software for the corporate arena.

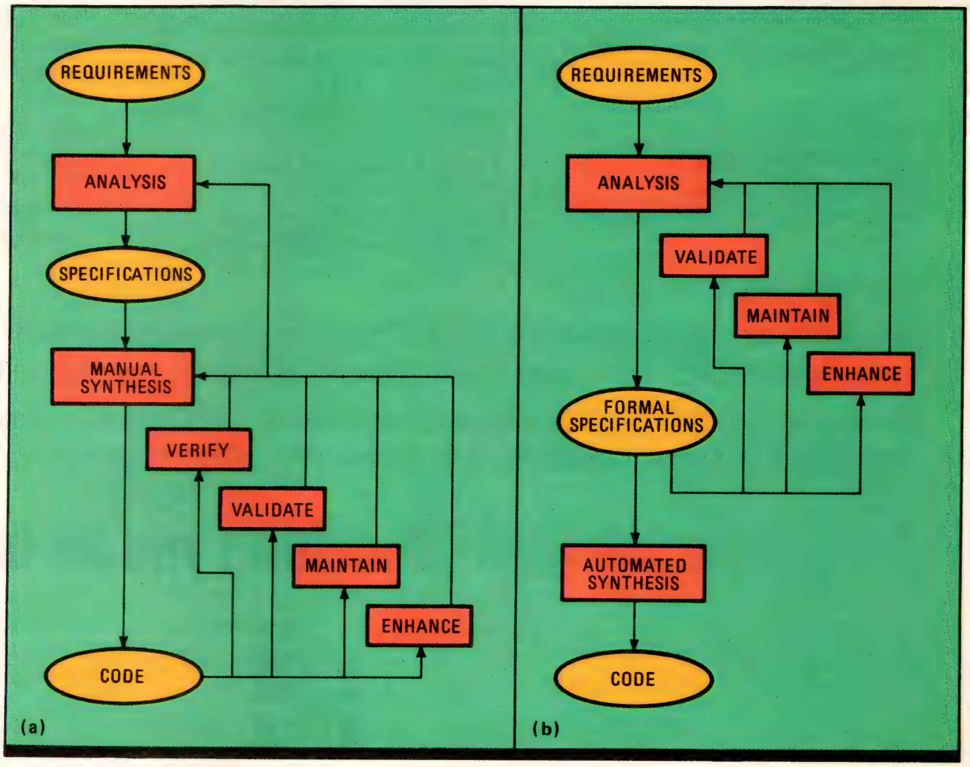
Particularly high on the cost-conscious engineering community's list is life-cycle support. The software life cycle lasts from specification until obsolescence and encompasses configuration control, documentation, and maintenance—often over a period of 20 years. In the past, these areas have been neglected. Yet engineers now realize that future systems, which will run to millions of lines of code, will be impossible to manage effectively without all-inclusive tools.

In the future, AI may offer the best hope for dealing with the burgeoning complexities of software development. "We're trying to address the difficulties in building general software packages by using a tool that is built on AI technology," says John Anton, president and cofounder of Reasoning Systems Inc., Palo Alto. The company's research on a knowledge-base approach to software design has resulted in a sophisticated expert system for software development.

Reasoning Systems wanted to automate the entire software life cycle, supporting the software-development process from specification through maintenance. But such an ambitious goal could not be built on existing tools and techniques, according to the company. Thus the AI knowledge-base approach was required.

"Knowledge based means that some of the diverse logical materials of the programming process are factored out and represented formally in a knowledge base," said Reasoning's senior computer scientist Gordon Kotik in a recent paper that he cowrote. This knowledge base takes the form of rules; the current version is written in the AI programming language ZetaLisp.

Reasoning's system is used to generate working programs. The manual method of generating code from specifications (Fig. 1a) becomes automated (Fig 1b). In practice, the user would begin by entering a specification. Next, the process of incremental refinement begins. The specification is run through the system and is analyzed according to the rules



1. AI APPROACH. Traditional software-development techniques (a) use manual iteration. The artificial-intelligence knowledge-base approach (b) automates analysis at the specification level.

stored in the knowledge base. Through applying the rules, the specification is decomposed and refined into a more detailed structure, one that is a step closer to the target machine code.

This process is repeated. Successive levels of rules are applied to the specification to get it to progressively lower levels. Finally, the specification will emerge rewritten in the target programming language.

Working from the specification level is the key to Reasoning's claim of a new way to support the software life cycle. The system validates all user designs, upgrades, and changes at the specification level. This ensures that design errors—such as a deadlock situation in a real-time system—are caught before the implementation, or coding, stage.

Just as important, specification, design breakdown, coding, and documentation functions are, in effect, integral. A change in the specification will automatically ripple through the system and be factored in. This is in marked contrast to the typically haphazard and error-prone approach to updating. It is well known among engineers that the final code rarely matches the specification, which often makes maintenance extremely difficult.

A SELF-DESCRIBING COMPILER

The real power of Reasoning's technology becomes apparent, the company claims, when the general programming knowledge stored in the knowledge base is coupled with domain-specific knowledge. Domain-specific knowledge takes the form of AI rules that represent information on the applications environment. Thus an aerospace company might load up on rules that relate to the special requirements of real-time avionics software; another company might focus on compiler-development rules. This is somewhat analogous to taking a stripped-down medical AI-based system and customizing it for either an orthopedic surgeon or an ophthalmologist.

Perhaps the most interesting feature of Reasoning's system is that it is self-describing. This means the system's compiler could generate the code for itself from a specification-level description of itself.

Anton emphasizes that Reasoning is not offering a product so much as a technology. The company does have a commercial knowledge-base system, known as Refine, but is not making it available off the shelf. But Reasoning is marketing its technology. Most recently, Lockheed Missiles and Space Corp. signed a long-term contract with Reasoning Systems. The agreement calls for the development of knowledge-base applications generators in communications and other embedded systems, and for training Lockheed personnel in the company's technology.

Ever since Go To statements became taboo with the advent of structured design, programmers have been desperately seeking structure in their software. A host of techniques have evolved to help them in their quest to design the well-tempered program.

Of these, the Yourdon design methodology has emerged as perhaps the most popular tool. The Yourdon technique is also referred to as the DiMarco methodology, after Tom DiMarco, author of a widely read book on the subject. It offers a way to look at complex problems and determine the best way to turn an idea into a program consisting of multiple modules.

One company, Yourdon Inc., New York, has done missionary work, bringing the techniques to industry through training courses and seminars. Yourdon and the Cadware Group Ltd., New Haven, Conn., formed a joint venture to develop and market Yourdon design tools. The products, sold under the new Yourdon Software Engineering Co. banner, will run on personal computers.

Its just-announced Analyst Toolkit is gaining acceptance, according to Paul Radding, president of the new concern. Engineering companies are already familiar with the idea of designing hardware using tools such as computer-aided design and manufacturing, he says. "They readily see that these same types of tools can be applied to the software world to increase programmer productivity."

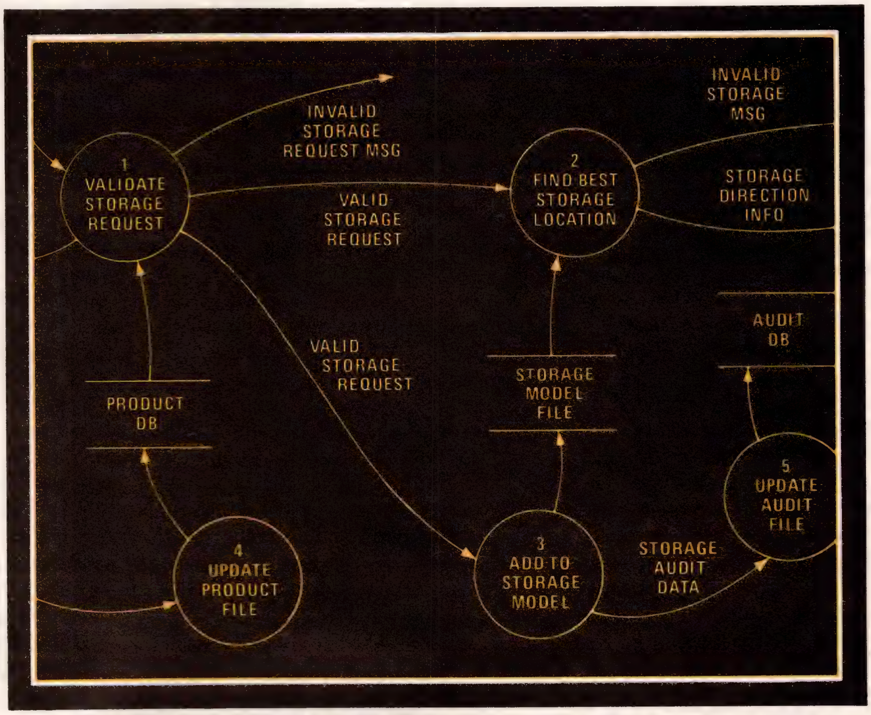
COMPUTER-AIDED PROGRAM WRITING

The Analyst Toolkit implements the concepts explored previously in Yourdon's training courses. "We've taken all the methods and the techniques that we've been teaching for the last 10 years and put it all on the computer," says Radding. The toolkit focuses on the analysis side of the software-design process, notes Radding. To this end, it implements three different types of graphics that are specific in the Yourdon design methodoloy: data-flow diagrams, entity relationships, and state transitions. In addition, the system has a documentation facility as well as the ability to tie the system in to such existing products as programs for data-base management.

"I think there's really a difference in philosophy between ourselves and some of the other tools that are out there," says Radding. "We don't believe the world needs yet another screen painter or report writer, especially at the personal computer level. Our effort is to provide a reasonably low-cost tool for analysis and design."

Analyst makes structured design more practical because it makes it easier to do, says Radding. "We teach people that if you follow all the rules, you get a really fantastic system. The problem is that when it's very labor-intensive, people tend not to follow all the rules. With the automation, you can type in a few commands and get the assistance of the computer." Thus an engineer can concentrate more on the analysis portion of a project, experimenting with different designs by trying out different data-flow diagrams.

More than 400 Analyst Toolkits have been sold since the

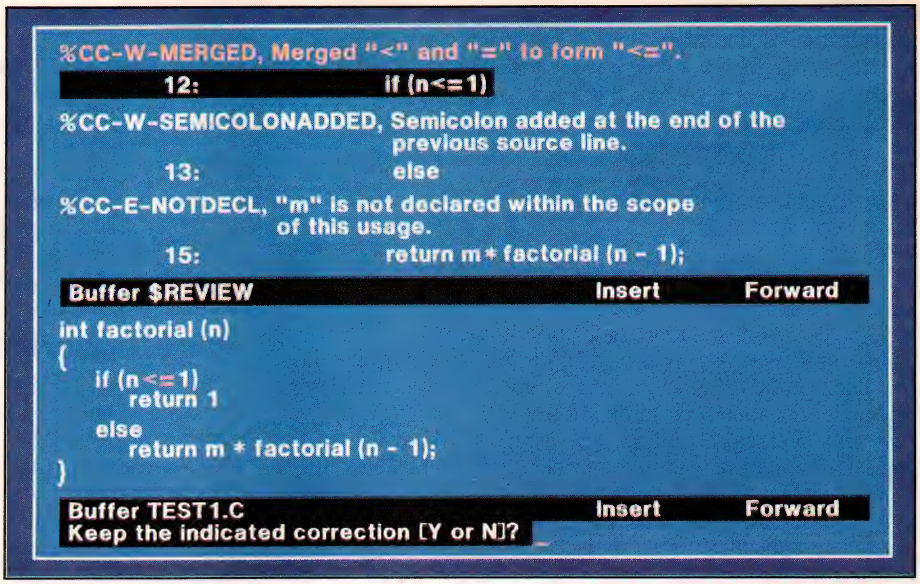


2. STRUCTURED APPROACH. Graphical representation of data-flow diagrams is the key to systems that make use of the Yourdon structured-design methodology.

product was introduced commercially this past March, though initial use and testing began a year earlier. It is slated for introduction in the UK late this year or early next year.

Also highly touted is Rule Tool, which lets users define their own strategies for developing software. "We think that Rule Tool is what really differentiates our product from the rest," says Radding. The Rule Tool, which is an optional add-on to the Analyst Toolkit, allows users to come up with their own symbols and methodology for building systems.

"So if you believe in using graphics, but not Yourdon graphics, you can design your own," says Radding. "The person within a company who specifies standards for systems development could implement those standards on our system." All analysts and programmers using the system would immediately be brought into compliance with these standards. Yourdon is now investigating using Rule Tool to implement documentation standards for military-software projects.



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%CC-W-MERGED, Merged "<" and "=" to form "<=".
        12:                  if (n<=1)
%CC-W-SEMICOLONADDED, Semicolon added at the end of the
                             previous source line.
        13:                  else
%CC-E-NOTDECL, "m" is not declared within the scope
                     of this usage.
        15:                  return m * factorial (n - 1);
Buffer $REVIEW                                Insert     Forward
int factorial (n)
{
   if (n<=1)
      return 1
   else
      return m * factorial (n - 1);
}
Buffer TEST1.C                                Insert     Forward
Keep the indicated correction [Y or N]?
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3. CATCHING ERRORS. Digital Equipment Corp.'s language-sensitive editor, shown in split-screen mode, automatically presents users with required and optional statement completions.

Another proponent of the Yourdon design methodology is Isdos Inc., Ann Arbor, Mich., which recently introduced Structured Architect, a software-design tool that runs on stand-alone personal computers. The product is actually the outgrowth of research begun in the late 1960s at the University of Michigan. At that time, Daniel Teichroew of the university's Industrial and Operations Engineering Department led a team seeking to automate the software-verification process. The result was Isdos's first product, a mainframe-based structured-design tool called the Problem Statement Language/Problem Statement Analyzer.

Now the company is tackling the IBM Corp. Personal Computer and PC-compatible software-tools market. "We haven't seen anything that does as much on a PC as our product does," claims company president Teichroew. Structured Architect, which offers graphical representation of data-flow diagrams (Fig. 2), features a built-in "encyclopedia" of Yourdon rules. The encyclopedia manages all information about diagrams, processes, and data. Thus it detects design errors and alerts the user to them. In addition, Structured Architect automatically produces documentation, including standard reports such as minispecs and data dictionaries.

Though a big-picture approach is essential to the success of a project, each effort is distinct. Analysis tells what it is that has to be done, whereas design defines how it is to be done, notes marketing manager Joseph Oates.

"We focused on the front end of the [software] life cycle, where the requirements were," says Teichroew. The front-end, or analysis, phase of a software project is critical, argues Oates. Typically, 40% to 70% of a programmer's time is spent on clerical tasks, he says. Structured Architect automates these, so users are free to concentrate on designing. "Structured Architect should double productivity and at the same time produce a much better product for hand-off to the next stage of the design process," Oates says.

Further along the design chain, the company has developed a new software package designed to fit between the Structured Architect and the Problem Statement Language/Problem Statement Analyzer. Its function is to manage the software-integration process on projects with multiple programmers. This package checks software changes and updates for validity and determines whether the individual programmer is authorized to make that change (a function called scope of authority). The idea is to catch all the errors before the implementation phase, says Oates. He claims that the package will provide the same "integration integrity" as would be obtained with a 24-person review process.

Program design languages are also aimed at imposing structure on software design. These tools have made marked inroads into engineering over the past several years. Program design languages are an English-like formalized notation used to represent the operation of a program. For software engineers, they are thus a sort of *lingua franca* on printout paper. Ideas can be reviewed, analyzed, and refined without having to wade through the complexities of a full-blown programming language.

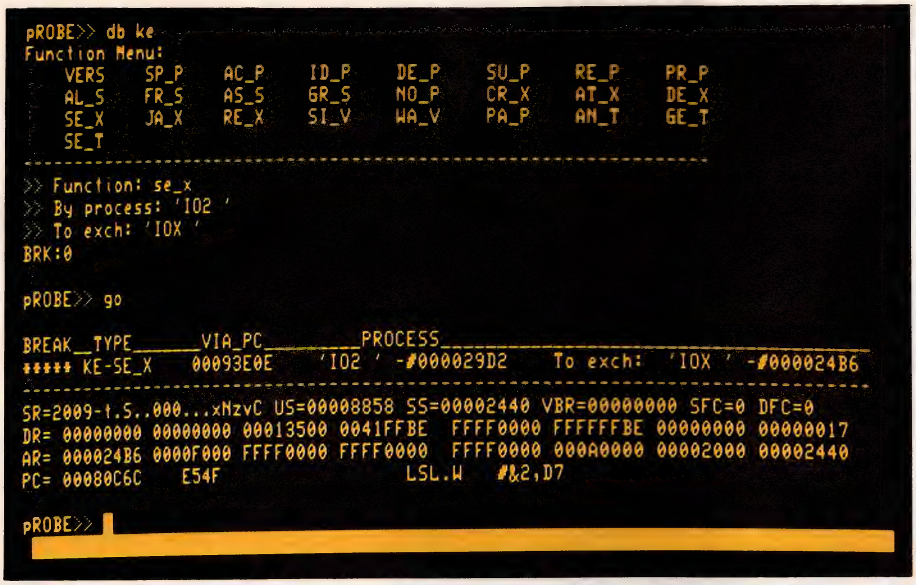
GOODBYE, FLOW CHARTS

A program design language should provide a framework for expressing a number of software architectural concepts, according to Nancy Yavne, an engineer at Mayda Software Engineering, Rehevot, Israel. These include allocation of functions to modules, definition of data structure, definition of procedural structure, and specification of intercomponent and external interfaces.

For maximum effectiveness, the language should be used on a project through the full software life-cycle. During the requirements-gathering stage, it serves as a communicator between customer and programmer. In the design phase, it will express the decomposition of the project into modules and interfaces. When programming, it will allow for step-wise refinement. In the lab, the program design language will help direct testing and debugging. And during maintenance, it will allow for a repeat of the entire process for each new version of the software.

With the advent of modern software-engineering techniques, program design languages have almost completely replaced flow charts as the preferred means of software documentation. Mayda's SDP, for Software Development Processor, is typical of current offerings. It requires a minimum of 64-K bytes of memory and is available in versions for IBM, Control Data, Digital Equipment, and Data General machines. An Ada/SDP, for generating a program design language compatible with the Ada programming language, will be upcoming in DEC's VAX/VMS, Data General's MV, and Unix system versions.

In industry, a package now popular is Caine, Farber, and



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pROBE>> db ke
Function Menu:
    VERS     SP_P     AC_P     ID_P     DE_P     SU_P     RE_P     PR_P
    AL_S     FR_S     AS_S     GR_S     NO_P     CR_X     AT_X     DE_X
    SE_X     JA_X     RE_X     SI_V     WA_V     PA_P     AN_T     GE_T
    SE_T
-----------------------------------------------------------------------
>> Function: se_x
>> By process: 'I02 '
>> To exch: 'IOX '
BRK:0

pROBE>> go

BREAK__TYPE______VIA_PC_________PROCESS____________________________________
***** KE-SE_X    00093E0E     'I02 ' -#000029D2    To exch:  'IOX ' -#000024B6
---------------------------------------------------------------------------
SR=2009-t.S..000...xNzvC US=00008858 SS=00002440 VBR=00000000 SFC=0 DFC=0
DR= 00000000 00000000 00013500 0041FFBE  FFFF0000 FFFFFFBE 00000000 00000017
AR= 000024B6 0000F000 FFFF0000 FFFF0000  FFFF0000 000A0000 00002000 00002440
PC= 00080C6C    E54F                     LSL.W   #&2,D7

pROBE>>
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4. PROFILES. Software Component Group's Probe 68K, a debug and analysis tool for use with Motorola's 68000 microprocessor, supports display and alteration of register and memory content.

Gordon's PDL, used by GTE Communications System Division to aid in designing software for large defense projects. Other available languages include Logicflow, from Logicon Ltd., London, and Schemacode, developed at France's Ecole Polytechnique. In addition, Ada-based program design languages are offered by IBM, TRW, GTE-Sylvania, and Softech.

A LANGUAGE TEMPLATE

Many major computer and software houses are taking a cue from PDL in that they are focusing on the full software life cycle. Most are not content to market single software-engineering tools. Instead, a brute-force approach seems to be the rule. Catalogs contain dozens of product listings as the companies look to woo a wide range of potential customers from the software cradle to grave.

At Digital Equipment Corp., Maynard, Mass., cooperative marketing agreements with outside companies are the means to broaden the range of software-development tools available to users. "We're expanding our focus to look at tools which support the entire life cycle," says Mike Kendall, marketing manager in DEC's engineering systems group.

In the upfront area of requirements analysis, DEC is performing a technical evaluation of the Tektronix Inc. SA design tool, with an eye toward a cooperative marketing agreement. SA will run on the VAX family. A graphical analysis tool, SA runs in a multiuser environment for lower cost; it can also operate in a single-user work-station mode. Currently, DEC and Tektronix have a cooperative marketing agreement for Tektronix's microprocessor-development tools that run on VAX/VMS and VAX/Ultrix-based computers.

For a project's software-design phase, DEC is cooperatively marketing several program design languages to run on VAX systems. A popular product, according to Kendall, is SuperPDL, from Advanced Technology International, New York. DEC also offers Mayda's SDP and Ada/SDP.

One home-grown DEC design tool is the VAX Language-Sensitive Editor (Fig. 3), which gives programmers a template, or layout, for the language they are working in as well as all the proper formatting, with indentations already in place. In addition, it performs verb completion and shows users required and optional statement completions.

For example, a user might enter an If statement. On a single-keystroke command, the Language-Sensitive Editor will complete the statement, showing its basic structure and, in parentheses, what is optional and what is required within the statement. "For people who are just getting up to speed on the syntax of a language, this is a great help," says Kendall.

The editor is available for use with a variety of programming languages including Fortran, Pascal, C, and Bliss. But the key language is Ada, says Kendall, and not coincidentally, it is lengthy and time-consuming to learn. A user can call the compiler from the editor; both editor and compiler work together in a split-screen windowing mode. "It gives you a very tight loop for writing code, changing it, debugging it, and going back again while staying in one multiple tool," says Kendall.

During testing, DEC's VAX Performance and Coverage Analyzer allows software engineers to catch errors that may have slipped past ordinary debugging methods. It collects data on how much time is spent in a module, what registers are accessed, and what source statements are called. The information can be displayed in histogram or numerical form. Such testing can catch a subroutine that is never called in the course of executing a long program, thus pointing up a possible design flaw.

Data General Corp., Westboro, Mass., has also brought a number of outside manufacturers into its software-tools fold. For managing the software-development process, Softool Corp.'s Softool productivity system is offered. And for Eclipse users working in the Pascal programming language, Data General is offering the MicroSet-86 and PascalSet cross-development tools from First Systems Corp.

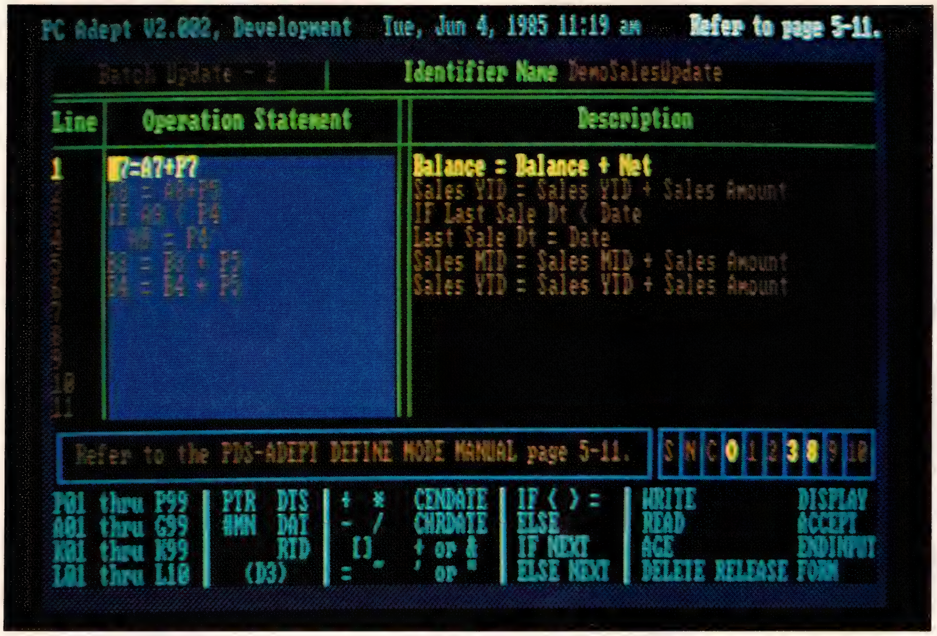
Microtec Research Inc., Sunnyvale, Calif., a maker of tools for microprocessor developers since 1974, has also hooked up with Data General. The company's assemblers, loaders, compilers, and debuggers support target-code generation for some 20 microprocessors including Intel's 8086, Motorola's 68000, and Zilog's Z8002. Data General is cooperatively offering the company's tools for its Eclipse line of superminicomputers.

For applications aimed at the 68000 chip, a debugging and analysis tool comes from Software Components Group. The Santa Clara, Calif., company's Probe 68K features system profiling—that is, a display of the status of the program under test (Fig. 4). Register and memory content can be altered during the debug session by the user. In addition, the user can query Probe on the state of the system at large and of selected processes.

System incident breakpoints are a unique feature, says marketing manager Stuart Schlitt. The product can trigger breakpoints on events, or incidents such as kernel calls, state changes, and input/outputs. Thus process-state changes, message and event passing, and resource and I/O requests can be captured selectively to pinpoint trouble spots in the user's software design. Under development is an enhanced version of Probe, as well as tools aimed at Motorola's 68020.

DEBUGGING IN SIMULATION

For probing real-time systems territory comes another software tool, from Systems and Software Inc., Costa Mesa, Calif. The company recently introduced SoftProbe/87, a software package that simulates the execution environment of Intel 8086, 8087, and 80186 microprocessors on a Digital Equipment Corp. VAX superminicomputer or a Motorola MC68000-based computer. "This translates into added software-development productivity, because the entire process of debugging and testing can now take place on the multiuser host, prior to



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PC Adept V2.002, Development   Tue, Jun 4, 1985 11:19 am     Refer to page 5-11.
 Batch Update - 2    Identifier Name DemoSalesUpdate
Line   Operation Statement          Description
1                                   Balance = Balance + Net
                                    Sales YTD = Sales YTD + Sales Amount
                                    IF Last Sale Dt < Date
                                    Last Sale Dt = Date
                                    Sales MTD = Sales MTD + Sales Amount
                                    Sales YTD = Sales YTD + Sales Amount
10
11
 Refer to the PDS-ADEPT DEFINE MODE MANUAL page 5-11.   S N C 0 1 2 3 8 9 10
P01 thru P99 | PTR  DTS | +  *   CENDATE | IF < > =  | WRITE              DISPLAY
A01 thru G99 | #MN  DAT | -  /   CHRDATE | ELSE      | READ               ACCEPT
K01 thru K99 |      RID |  []    ↑ or ↓  | IF NEXT   | AGE                ENDINPUT
L01 thru L10 |   (D3)   | =  "   ' or "  | ELSE NEXT | DELETE RELEASE FORM
```

5. ADEPT. The PDS-Adept applications generator guides business data-base users through a series of questions, or parameters, that are used to drive the package's data-processing functions.

target hardware prototype availability," according to company president Y. P. Chien.

The simulator allows symbolic debugging of a user's program. In addition, it offers program-execution trace. Program execution history may be displayed in either assembly-language statements or high-level-language statement numbers. Through an on-screen windowing interface, SoftProbe allows switching between debugging, editing, and compiling modes.

Some manufacturers are combining debuggers with editors and analyzers into one streamlined package. Known as software-development environments, they are meant to serve as self-contained laboratories for designing programs. Today, the trend in software environments is evolutionary rather than revolutionary. In fact, many such systems have hit the market over the past year.

Business-software developers are seeing some equally interesting new tools. An additional twist is that many of these business-oriented tools are aimed not at traditional software developers but at users farther down the software chain.

In this area, Mainstay Software Corp. has carved out a niche for itself. The Denver company markets a software package—also called Mainstay—that combines a mainframe-like analytical data-base-management system with a readily tailored user interface. Running on IBM PC/XTs and PC ATs equipped with hard disks, the package allows value-added resellers to rapidly build sophisticated custom software products, according to Mainstay president Dan Walkovitz.

Typically, data-base systems and spreadsheets have been separate entities, says Mainstay cofounder and vice president of product development David E. Bakkom. "What we've tried to do is break the underlying pieces [of each system] down to building blocks and put the best pieces of each together."

Applications programs are generated using menus provided by the Mainstay software. One menu sequence, called the form painter, lets programmers design screens using a standard template. Definition of the screen fields as well as variable names, type, and range are all handled by menus. In addition, the software has what Mainstay bills as a unique data-base manipulation feature. "Multidimensionality allows you to look at the slices of data that you want," says Walkovitz.

One of Mainstay's target markets is the rapidly growing electronic information industry. Companies such as Dun & Bradstreet, McGraw-Hill, and Dow Jones are investing heavily in technology to manage their huge data bases and deliver information to subscribers through computer networks. Mainframes control much of this front-end information processing.

But Mainstay gives end users—the information-service subscribers—the ability to analyze and manipulate the data they have purchased on personal-sized machines, its developers say. In fact, several such applications programs, developed using Mainstay, are already on the market. These include the Microscreener data-base program, developed by Standard & Poor's Compustat Division for its subscribers, and the United Bank of Denver's Deal Maker.

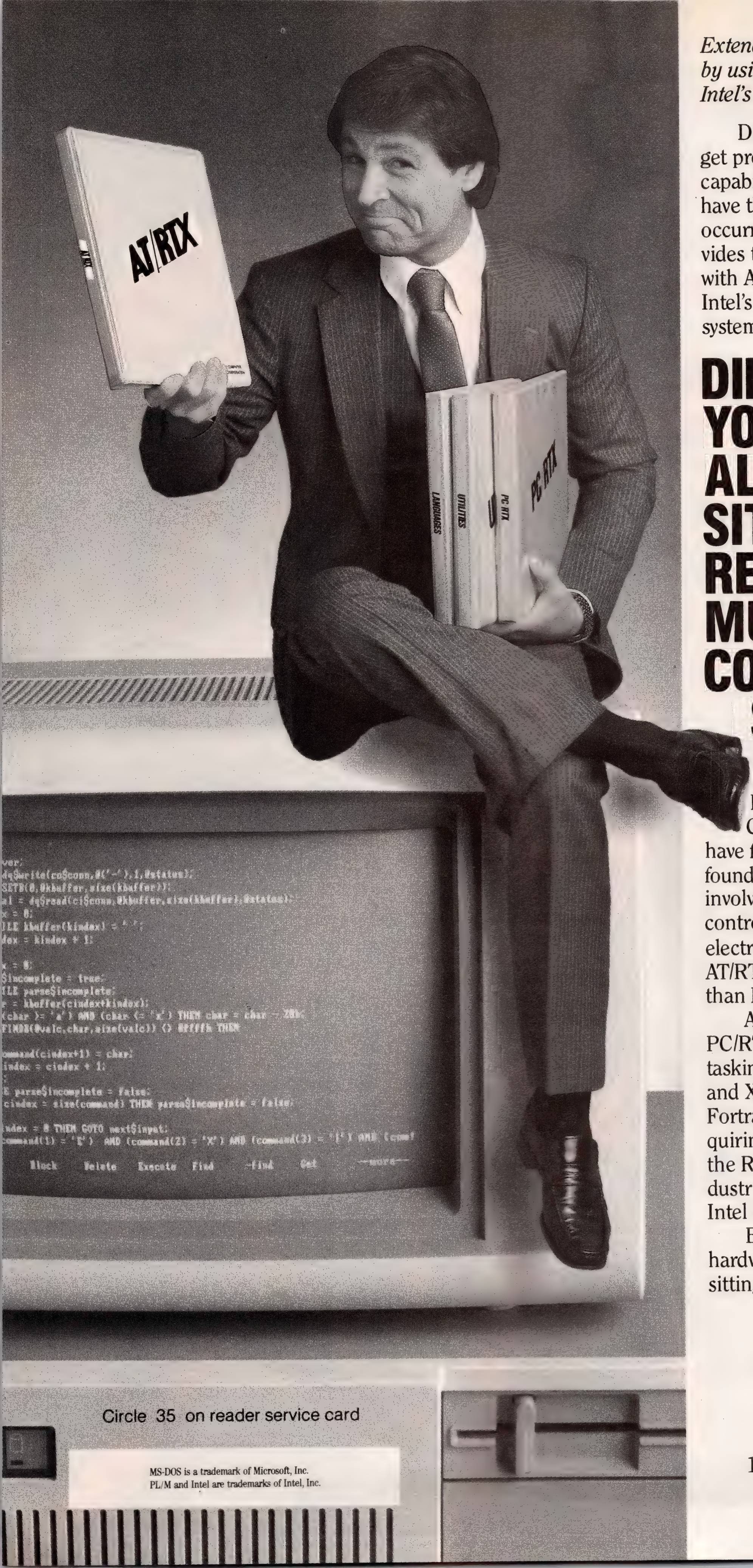
Such applications generators—packages for users to rapidly develop prototypes and test applications software—may be the wave of the future in the business world. They do have limitations—for example, they cannot develop extremely complex, highly customized programs—yet they are perfectly adequate for developing programs to design forms and analyze many kinds of data-base information.

A new applications generator that specializes in data bases for business was recently announced by Parameter Driven Software, Birmingham, Mich. The PDS-Adept applications generator is menu-driven. It guides users through a series of questions, or parameters, that then drive the package's data-processing functions (Fig. 5). Two sequences guide the user through designing a form and specifying the calculations to be performed on selected data. The company claims that, with minimal training, users without programming experience can develop general ledger, accounts receivable, and inventory applications programs, among others.

OVER THE HORIZON

Beyond the latest products offered for software design and business applications loom improvements that will enhance the software environment even further. Eye-catching may be the best way to describe another class of tools that will play an important future role in automating the first, or development, phase of the software life cycle. These are known as visual programming and visual simulation tools [*Electronics*, Oct. 7, 1985, p. 49]. The idea is to bring the software designer closer to the implementation process through the use of visual software models. These tools will be more sophisticated than most currently available graphical-design aids, delving deeper into the intricacies of a developer's software. Current research in this field is under way at AT&T Bell Laboratories, Brown University, the University of California at Berkeley, and the University of Southern California.

Also among tomorrow's toolsmiths will be the Microelectronics and Computer Technology Corp., the Austin, Texas, high-tech consortium. MCC's Software Technology Program has recently announced project Leonardo, for Low-cost Exploration Offered by the Network Approach to Requirements and Design Optimization. Leonardo's long-term goal is reportedly a prototype-development environment, whose technology will be more advanced than current industry efforts in software-development environments. Improving engineers' productivity throughout the software life-cycle is one aim of this environment. ☐



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TECHNOLOGY UPDATE

5

CONSUMER

MANUFACTURERS REFINE ESTABLISHED TECHNOLOGIES

by David M. Weber

VCRs are getting smaller yet have more features. Optical memory is bigger and simpler. And liquid-crystal TV is brighter than ever. But until manufacturers bring down prices, consumers will still buy equipment based on established technologies. Last part of a 5-part series.

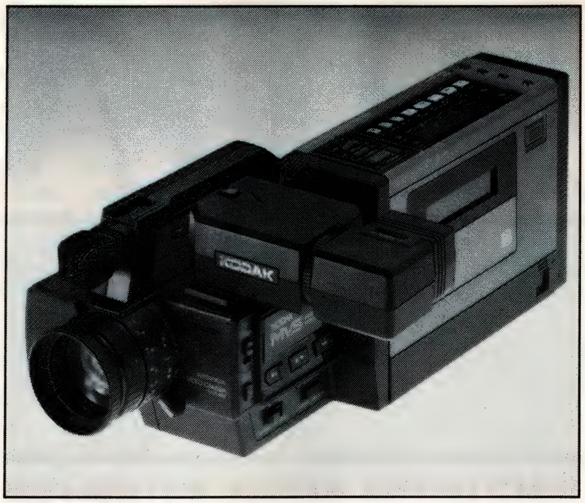
The most recent surge of new technologies into consumer products happened in the halcyon days of the early 1980s when such innovative products as personal computers and video cassette recorders burst on the scene. This has slowed considerably in the past year or so, as designers focused more on refinements to existing products rather than coming up with entirely new product categories.

These technical refinements, however, are resulting in a host of product improvements that are highly visible to customers. New models of VCRs, for example, are smaller and lighter thanks to a higher-density video tape coated with chromium. Charge-coupled-device imaging technology is being honed for use in still-video photography. These improvements are ushering in the era of all-electronic cameras. And the optical disk promises to store huge amounts of audio, video, and textual data. Liquid-crystal-display technology is also leading the way to flat-screen TVs that will use less power than a CRT without sacrificing any picture resolution.

These technology improvements are helping to fuel a still-robust demand for most categories of consumer electronics. The dollar value of the home electronic entertainment and information-systems market should grow about 20% annually from now until the end of 1987, giving manufacturers the capital to develop and market new products as well as to explore new technologies for the next generation of equipment. This year, U. S. consumer-electronics sales will hit $25 billion.

Leading the market will be VCRs, growing at a U. S. sales rate of about 40% annually. Worldwide, 11.5 million VCRs will be sold this year. But manufacturers cannot count on such growth much longer—VCR makers have enjoyed 100% annual growth for the past four years—because the market may be nearing saturation. So most manufacturers are looking hard for new growth products.

Sony Corp. is one of them. It has adopted a bold strategy to pique the interest of jaded consumers as well as to combat any softness in VCR sales due to saturation or to the growing worldwide dominance of the competitive VHS format. The Tokyo company is billing its 8-mm camcorder as the eventual standard for home video recording; it aims to eclipse 8-mm film as well as competitive electronic formats.


MODULAR. With Kodak's 8-mm video system, consumers can mix and match components for several imaging options.

Sony's designers put several technical innovations to work in the Mini-8 CCD-M8U to wrest high performance from the small unit. The new camcorder is about the size of a paperback book and weighs 1 kg. The system owes its lightness and compactness to the development of high-density video tape coated with tightly packed chromium metal rather than the chromium oxide particles used in conventional video tape. Higher tape density permits image compression and leads to the miniaturization of the entire system by eliminating the need for ½-in. tape.

Replacement of the fixed-head control track of ½-in. VCRs is also pushing miniaturization. In the 8-mm format, four signals recorded with the video image onto the tape position the rotating heads. When the tape is played back, a signal processor within the Mini-8 automatically adjusts the relationship of the four signals for optimum picture clarity. The tape can be smaller because it doesn't need the extra track.

During playback, microprocessor-driven filters separate the video and FM audio-frequency components of the combined signal—which also serves to eliminate crosstalk when the signal is demodulated. In addition, the expanded frequency response made possible by the moving video heads permits the recording of pulse-code-modulation digital stereo. Voiceovers and background music can be dubbed in pcm onto previously recorded 8-mm video tape.

Another useful feature for dubbing is the flying erase head on the rotating drum. Unlike the fixed heads of conventional VCRs, which cut across several tracks as the tape is moved, the new erase heads can move independently and access tracks that the user chooses. As a result, the user can select individual fields to erase, so the editing looks more professional. "With the advent of 8-mm video, the home-electronics industry is seeing the disappearance of the distinction between audio and video and taking a turn toward the marriage of these media," says Sony president Norio Ohga.

VIDEO STILLS. In Kodak's System 7000, film images are transferred to a video disk, which users can then view on a home TV.

Other companies are tapping the potential of the 8-mm format. Like Sony, Eastman Kodak Co. is using CCD imaging technology and spaced, rotating video heads in its modular 8-mm video recorder. Under a marketing agreement with the Rochester, N. Y., photography giant, Toshiba Corp., Kawasaki, Japan, will manufacture several products based on the 8-mm video concept.

Kodak's modular video system differs from Sony's in that the recorder and camera function as separate units that can be linked by means of snap-in connectors. By offering consumers such options and accessories as autofocus, alphanumeric-character generation, and zoom lenses, Kodak is giving the user more creative control over personal and professional communications, says Charles R. Wilkinson, director of commercial markets development for Kodak's Consumer Electronics Division.

But the manufacturers of ½-in. camcorders aren't standing still. Matsushita Electric Industrial Co. and Japan Victor Corp. are continuing to shrink the size and weight of their VHS machines by reducing the drum diameter from the 62 mm in the first generation of camcorders to about 41 mm in the second-generation equipment [*ElectronicsWeek*, Jan. 7, 1985, p. 9]. Drum weight drops correspondingly from 255 g to 134 g. The unit maintains tape contact within a full-sized VHS cassette because the tape is wrapped 270° around the drum instead of the 180° in tabletop units. Faster drum rotation of 2,700 rpm, compared with 1,800 rpm, sustains the same 19-ft/s writing speed of standard VHS machines. The machine's four heads—each of which is 90° from its neighbor—provide the same repeating sequence of azimuth angle as in a full-size VCR, ensuring comparable picture quality.

To make the unit even more compact, designers have reconfigured the tabletop model's printed-circuit board to fit into the space freed by the smaller drum. Adding to the space saving of JVC's tighter tape wrap is an innovative cassette housing that fits the ½-in VHS tape into less space.

Until the 8-mm format is adopted more widely, even Sony will keep pursuing the ½-in. format in camcorders. Although Sony has not redesigned the camcorder's electronics or tape packaging as extensively as Matsushita and JVC have, its Beta-format machines also use a reduced-size drum (45 mm, compared with the Beta-standard 75 mm) and tighter (300°) tape wrap to achieve an overall size reduction on a scale comparable with that achieved by the VHS manufacturers.

Sony often takes the lead in introducing new technology. In 1982, chief executive officer Akio Morita toured the world to promote an invention that was to stand the photographic world on its ear. Originally scheduled for U. S. introduction in the spring of 1983, it was going to be the electronic alternative to a film camera in home photography. But the Mavica, for magnetic video camera, never reached retailers.

Unlike any other camera for the consumer market, the Mavica used a magnetic disk to record a still video image in color, which could be played back instantaneously through an adapter on an ordinary TV. With a special modem, also supplied by Sony, the image could be transmitted over phone lines anywhere in the

WRITE AND ERASE. Matsushita's erasable optical-memory disk recorder can place up to 10,000 video images on a 20-cm disk.

world: grandma in Hawaii could use her TV to see snapshots of little Heather's birthday party in Vermont as soon as they were taken. Cost for the entire system was to be about $1,000 once Sony ramped up for full-scale production.

However, another magnetic alternative to film is on the brink of resurrection this year, as Matsushita makes plans to bring out its own electronic still camera. The camera is based on the same CCD imaging technology that Sony used in the Mavica—which provides a resolution of about 300,000 pixels from a thin-film, double-gap video head. Other specifications are similar, too: high-resolution picture quality of 350 horizontal and 400 vertical TV lines; 50 pictures on an industry-standard (approved in May 1984 by 32 companies in the camera and video industries) still-video floppy disk; an exposure rate of seven shots per second for continuous photography, and the ability to transfer a video image to a printer or to a distant receiver by modem.

Final marketing plans for the camera haven't been completed. But the Osaka, Japan, company will aim its new technology at users in industrial and medical fields before it targets consumers, say some market observers.

Kodak, too, sees the potential of still video photography but is taking a more cautious approach than that of its Japanese competitors [*Electronics,* Oct. 21, 1985, p. 20]. In Kodak's view, 35-mm film will continue to dominate home photography. "It'll be a decade or more before anyone makes an electronic still camera with the image quality of today's films," says Robert C. Sharp, vice president of Kodak's Photofinishing Systems Division. "But our market research shows that there is a great deal of consumer interest in 'soft' viewing—the ability to look at film on a TV screen." Video processing of 35-mm film images is an idea whose time is already here, according to Kodak.

Like Sony and Matsushita, Kodak will probably take a shot at the consumer market with a still video camera. But for now it is test marketing two new products: the System 7000, which permits the transfer of film images to magnetic disks in the 2-by-2-in. high-density metal-particle still-video floppy-disk format for viewing on a TV or monitor, and the Color Video Imager, which makes color prints of an image from a TV or a monitor.

Kodak is conducting market tests for the 7000 at its processing laboratories. The labs are expected to handle about 20 orders a day. During the transfer procedure, the film is scanned and optimized for TV. With a joystick, an operator corrects color balance, brightness, and contrast on a waveform monitor before storing the image on the video disk.

The color video imager will go on sale early next year for a list price of $700. Kodak sees its biggest potential market among personal computer users who need to copy electronic spreadsheets.

Another development that points to the eventual marriage

FUKINUKI SHARPENS THE TV PICTURE AT HITACHI

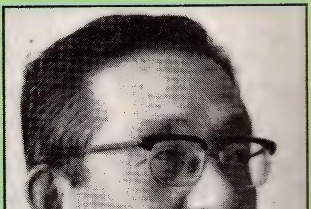
by Charles L. Cohen

The quality of future TV broadcasts in Japan, the U. S., and other nations using NTSC TV standards should be enhanced because of the work of Takahiko Fukinuki and his group at Hitachi Ltd.'s Central Research Laboratory in Tokyo. Fukinuki is chief researcher and leader of the Signal Processing of Pictures Group.

Fukinuki and his group are the pioneers in developing the three-dimensional frequency-domain filters and motion-adaptive processing techniques needed to build improved-definition TV sets for NTSC broadcasts. Set manufacturers can implement improved-definition TV without the Japanese government's approval.

Fukinuki has spent his entire professional life in the development of digital electronics. At the Central Research Laboratory, he was able to work with frame memories long before there was any hope that they could become consumer products. Now the price of the one- and two-frame digital memories needed to implement these schemes is just dropping to levels suitable for the consumer market.

Fukinuki worked on digital switching systems from 1961 until 1967, when he switched fields to picture processing, giving him a good foundation for his future in digital TV. He completed that preparation in 1969 with a year of study sponsored by the company on TV signal processing at the Massachusetts Institute of Technology. At that time, MIT was the leader in the field worldwide, he notes.



TAKAHIKO FUKINUKI

Returning to Japan, Fukinuki started work on increasing the transmission efficiency of TV, although his efforts were directed to the ill-fated picture phone. He worked on redundancy-reduction coding using prediction coding, which he characterizes as a type of digital filter.

In the early 1970s, Fukinuki's group worked with frame memories populated with 1-K chips. Now, he notes, the day is fast approaching when a TV frame can be stored in only four chips, and the memory manufacturers will probably include peripheral circuits on-chip as well. The two frames needed for future improved-definition TV will be practical soon, he says.

In the late 1970s through the early 1980s, Fukinuki spent more than half of his time adapting G-III facsimile terminals to meet international standards. Then he went to work implementing improved-definition monitors, now available as professional products from Hitachi, and began to work in earnest on new broadcast standards.

His group's work is undoubtedly behind the Japanese government's decision to develop enhanced NTSC broadcast standards during the next three years. One reason is that his group appears to be prominent in articles on the subject in scientific journals.

Fukinuki obtained his BE and ME degrees in electronic engineering from Kyoto University. He obtained a doctorate in information engineering from the university in 1975, based on a dissertation on his work for Hitachi, a practice common in Japan.

of different entertainment and information media is the optical disk, which permits the storage and retrieval of huge amounts of audio, video, and textual information.

One consumer use of optical disks that looks promising is as a home-computer storage device that can access more than 550 megabytes of data, recorded permanently by laser on one 20,000-track 5-in. platter.

Whether these compact disk read-only memories take off in the home market depends on several factors. An important concern is development of an industry standard for their physical size and data-transfer speeds [*Electronics*, Sept. 16, 1985, p. 26]. How well they will sell also depends on the amount of software that will be developed for them. Early next year, Atari Corp. is expected to introduce a CDROM version of the Grolier Academic American Encyclopedia, to sell for about $200, including the associated search software—well under the $500 or so price of the encyclopedia's printed version. The CDROM player will sell for about $500 as a peripheral for Atari's new 520ST computer.

WALL UNIT. Epson's 13-in. prototype liquid-crystal-display TV offers better brightness than first-generation LCD TV and hints at things to come for flat-panel TVs.

The fact that CDROMs cannot be written to—as floppy disks can—may limit their penetration of the home computer market. To get around these limitations, Matsushita has developed an erasable optical recorder system based on a tellurium suboxide—a metal oxide used in conventional record and playback systems. Lasers can change the structure of recording materials made with a small amount of other metals such as germanium, indium, and lead. So the material can go back and forth between the crystalline and the amorphous phase. During record and playback, the highly reflective crystalline phase converts itself into the nonreflective amorphous phase. The opposite process occurs during erasure, which can be repeated upward of 1 million times, according to Matsushita.

Although the technology of erasable optical disks has become well established over the past year, the price for them and their players has not. Matsushita's player goes for about $30,000—too steep for the average consumer—although mass production will cut the price by a factor of 10, says Shigeru Hayakawa, senior managing director of research and development at Matsushita.

Meanwhile, Sony is developing a direct-read-after-write system (DRAW) that will allow consumers to use a modified CDROM player to record (once and for all time) their own software, whether it is data or music. The DRAW system is expected to sell for about $500.

FLATTER AND BRIGHTER

Since TV's beginnings, manufacturers have aimed for a truly portable set—one that could fit in a pocket or hang on a wall. Recently, several new products from Japan are bringing that goal closer.

The biggest developments during the past year were in liquid-crystal-display TV. Not surprisingly, the major players in that market came from the ranks of Japan's LCD wristwatch and lap-computer manufacturers, rather than from the traditional TV makers.

The technological basis of full color LCD television is the multiplexing of a large number of twisted-nematic pixels, with a thin-film transistor placed at each one. The thin-film transistor functions as a capacitor that provides a near-100% duty cycle for each pixel in the matrix—resulting in much lower power consumption than a cathode-ray tube and a very thin design: the average LCD TV is about ½-in. deep.

Current-generation LCD TVs, such as those from Suwa Seiko-Epson, Citizen, and Casio, use about 50,000 pixels in a roughly 2½-in.-diagonal format. This is only about 1/10 the number of pixels in a typical CRT, so definition is intrinsically poorer. Recently, however, Epson America, a division of Suwa/Seiko, announced a prototype of a 13-in.-diagonal LCD TV that has 250,000 transistor-driven pixels. No firm date for the introduction of this product has been set, but Epson expects to sell upward of 10 million units as second and third TVs to households in North America, says marketing manager Jerry Astor. Such market penetration would represent a substantial improvement over the some 500,000 LCD TVs sold worldwide in 1984.

In Epson's view, CRTs are about to lose their present advantage of high brightness and resolution over LCDs. In one improvement in LCD technology, azo dyes added to the host material improve the brightness and clarity of the crystals by eliminating the need for a polarizer. Other modifications, now in prototype, promise to lower the cost of LCD TV. "TFT displays with glass substrates [one fifth the cost of today's quartz substrates] will be used in the next generation of televisions," predicts Tashiaki Saito, director of research and development for Suwa Seiko-Epson. "In addition, ferroelectric smectic-C crystals will lower power requirements by reducing response time."

Liquid-crystal displays will give TV buyers an alternative to CRTs

The difficulty in bringing the new technology to the consumer rests on the delicacy of the new material: smectic-C crystals can exist only in two stable states. A narrow gap of about 2.5 µm is needed between the glass-plate electrodes to confine them in each state. Manufacturing techniques must therefore be refined before the crystals can be produced in quantity, and Epson estimates that a commercial product based on smectic-C technology is about a year away.

Technologies as firmly established as CRTs and film photography will not be unseated easily. But during the next year, consumers can expect a gradual shift in the focus of display technology—away from such traditional media as photographic film and CRTs toward magnetic media and LCDs. Consumers can look for a greater variety of VCRs that are cheaper and boast more features. But CDROMs must drop considerably in price before they make inroads in the consumer market. □

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BOARD TESTING REACHES ERA OF VLSI SPEEDS

HIGH-DENSITY PACKAGING OF ECL ALLOWS 80-MHz OPERATION

Very large-scale-integration modules and printed-circuit boards have developed beyond the technological abilities of traditional testing methods. Their high-density packaging—thick-film hybrid or surface-mounted pc board with high input/output pinout—allows higher data rates than can be achieved on standard pc boards. Only VLSI circuit testers have had a low enough skew (timing errors) and the 40- to 50-MHz data rates needed for module testing.

But existing VLSI testers are simply not equipped for testing modules whose hundreds of pins require the channel capacity of a board tester. In addition, device testers cannot do mixed analog and digital testing or the fault diagnostics that are needed for today's complex modules. Often, these modules are sealed, which precludes access to their internal nodes and eliminates any chance of probing the assembly.

Teradyne Inc. is about to fill this testing void with a new high-end functional tester that should be more than a match for the latest VLSI modules. Early next year, it will ship its L290 VLSI module test system (Fig. 1) for functionally testing high-speed high-performance electronic modules and pc boards. The L290, which was in development for 2½ years, evolved from the Boston company's L200 board-test line and represents an entirely new category of test systems, says L200 product manager George Mabry.

With a basic pattern rate of 40 MHz and test-channel skew as low as ±1.5 ns, "the L290 is the first board tester ever to approach the speed and accuracy levels associated with device testing," Mabry claims. At the same time, the system retains such traditional board-test features as high channel count, full analog and digital test capability, and extensive diagnostics.

A state-of-the-art package combines large emitter-coupled-logic gate arrays, densely packed thick-film hybrids, memories in chip carriers, and discretely wired controlled-impedance pc boards that are the equivalent of multilayer pc boards. That combination makes possible a string of features that result in signal integrity, circuit density, ease of test, and repair.

The features include a channel de-skew mechanism that calibrates the full system in less than five minutes, a 250-ps timing resolution, serial pattern processors that deliver long pattern sets to test channels for modules with built-in testing, and a direct-memory-access processor that bypasses the system's central processing unit to load channel memory at 500,000 pin instructions per second. In addition, the L290 has up to 1,152 bidirectional test channels and a pattern rate as high as 80 MHz, achieved by interleaving channel output devices. And there is no dead time in the L290's pattern cycle.

The heart of the L290 is a special card frame, directly beneath the system's test fixture, for holding the module or pc board under test. This frame holds up to 48 boards, each measuring 15 by 20 in. and containing up to 24 test channels. Lead length is critical in high-speed operation, so the cabling from the channel cards to the unit under test in the fixture is held to only 4 to 8 in.; in competing testers, the lead length typically is 2 to 3 ft.

Packaging of the channel cards (Fig. 2) is critical to the tester's performance and its component and interconnection density. Advanced packaging technology greatly sharpened these parameters in the new D6 and D7 cards. There has been an eightfold improvement in pattern rate, a tenfold improvement in channel skew, and a fivefold improvement in pin-electronics component density since 1980. In fact, the channel cards of the L290 represent a considerable improvement in the same parameters over 1984's channel cards (see table).

To ease the problems of testing during manufacture, and of modification and repair, the channel cards are composed of plug-in modules rather than having all components soldered directly into the board, as is done in many of today's commercial electronic test systems.

Much of the critical circuitry is housed in three module types—digital logic, pin electronics, and memory. Almost all the digital logic for each channel's electronics consists of large cus-

1. **SPEEDY BOARD TESTING.** Teradyne's L290 tester, with 1,152 bidirectional test channels, nears the speed and accuracy of VLSI device test systems.

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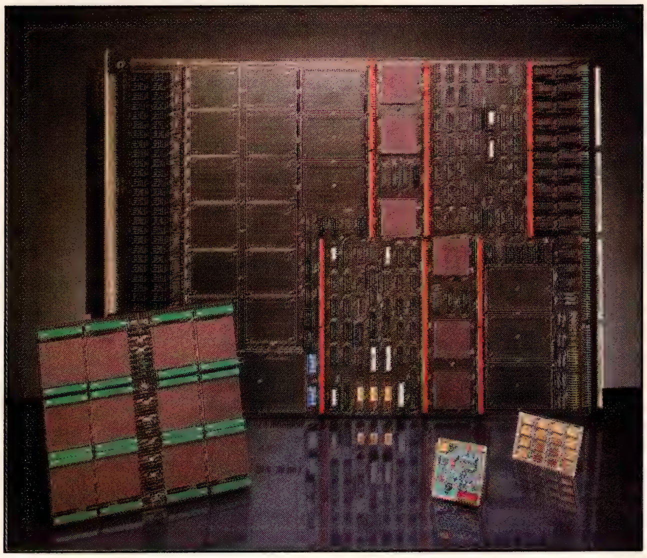

2. CHANNEL CARD. A partially assembled D7 card holds a variety of modules. The D7 uses plug-ins rather than soldered components.

tomized ECL gate arrays in pin-grid-array packages housed on small multiwired controlled-impedance substrates. These substrates are plugged into the main channel card.

The pin electronics of each card consists of 12 stacked hybrids. Each stack uses two-sided, 1.8-by-2-in., thick-film ceramic substrates (Fig. 3) having surface-mounted components on top and screened-on resistors on the bottom. The substrates, which have peripheral pins on 100-mil centers, are stacked vertically. The resulting assembly plugs into special hollow pins on the motherboard. The D6 card, a 12-channel unit, bases its pin-electronics modules on a stack of two hybrids; the D7 card's pin electronics takes a three-stack hybrid.

The third module type, the memory array, is a small, rectangular ceramic substrate carrying fast static random-access memories packaged in rectangular leadless chip carriers. The memory generates considerable heat, so the top side of this assembly has an array of piston-like metal heatsinks, which are cooled by forced air. Three of these modules plug into the D6 card and six into the D7 card.

The main channel card, which accommodates all the modular assemblies plus other circuitry, consists of four power planes plus two outer layers of extremely dense Multiwire, insulated wires embedded in the surface of an adhesive-covered board. The Teradyne channel card uses 4-mil insulated wire in its multiwired portions, rather than the usual 6.3-mil wire of a standard multiwired board. The finer wire allows three wires to be run between plated through holes. This, plus a 50-Ω characteristic impedance, results in the equivalent of a 14- to 16-layer pc board.

The Teradyne functional board tester has a particularly low test-channel skew. To maintain the low channel-skew specifications throughout the system, the L290 incorporates a unique channel-to-channel de-skew mechanism.

CHANNEL-CARD EVOLUTION

Year introduced	1980	1984	1985	
Channel card	D3	D5	D7	D6
Number of channels	24	24	24	12
Pattern rate (MHz)	5	10	40	40
Pattern depth (K)	1	4	up to 32	up to 32
Channel skew (ns)	±15	±10	± 3	± 1.5
Digital electronics (equivalent ICs)	250	800	2,300	2,300
Density of pin electronics components (per in.^{2})	25	50	125	125

During calibration, loops connecting all the tester's timing generators with each test channel's drive and detect circuitry feed back channel outputs to the generators. This sets up a ring-oscillator effect, whose frequency is measured by a timer counter to calculate the amount of channel delay. Variable-delay de-skew circuitry corrects the delay, and at that point calibration is complete.

In addition to the de-skewing circuitry, the L290 is the first board tester to eliminate dead time—portions of the pattern cycle during which signal edges may not occur. Freed of this restriction, test engineers can specify drive phases anywhere in a cycle, and therefore emulate more accurately the complex timing of a system under test.

The absence of dead time in this tester means detect edges and windows can be programmed to occur at any point of the pattern cycle. This allows test engineers to maximize fault coverage by using programs providing more precise observation of the responses of the unit under test.

The L290's fine timing resolution and its elimination of dead time ease the task of generating high-quality test programs. For timing, a 40-MHz period generator specifies pattern-cycle duration in 500-ps increments. A maximum of 32 timing sets is available to specify placement of drive phases and detect edges or windows within each cycle. Drive phases and detect edges or windows are programmable in 250-ps increments, and they can occur as little as 10 ns apart within the cycle.

SYSTEM ARCHITECTURE

The basic architectural components of Teradyne's functional tester are the computer group, the digital subsystem, and the analog subsystem. The L290 is built around DEC's MicroVax II processor, which supports a maximum main memory of 9 megabytes. Existing L200 family software for functional programming, testing, debugging, and diagnostics has been adapted from the DEC PDP-11 processor (used in previous L200 models) to run in the VAX environment to provide compatibility between the L290 and other L200 systems. This also permits Teradyne's Lasar Version 6 simulator, which is used for test-program generation and runs on a VAX, to run on the L290. The new system supports either a standard DEC VT241 color cathode-ray-tube terminal or an optional DEC VAXstation II for programming. Other system peripherals include a Centronix dot-matrix printer and a Winchester disk drive.

The two new channel cards, the D6 and D7, can be mixed with any other L200-series digital channel cards. Any of the 40-MHz bidirectional channels on either the D6 or D7 may be interleaved to produce an 80-MHz pattern rate. The D6 card maintains channel skew to within ±1.5 ns; drive detect and load levels are independently programmable for each of its 12 channels. The 24-channel D7 card holds channel skew to within ±3 ns and its levels are programmable on a cardwide basis.

For efficient testing of VLSI boards and modules with level-sensitive scan design and other built-in test configurations, a new serial-pattern-processor card is available with the L290, as well as with other L200 series testers. The serial pattern processor delivers the lengthy serial data required for shift-in and shift-out operations involved in checking internal states of a module or board that has built-in test circuitry. Each serial-pattern-processor card sources up to eight shift-register paths with a total of 16 million serial patterns; multiple cards can be used on the L290. A bidirectional digital matrix, programmable to switch patterns from the serial-pattern-processor signal source to any specified test channel in the system, eliminates fixturing changes when testing new board or module types.

The L290 has two options for testing embedded memories. A microprogrammable algorithmic pattern processor provides maximum flexibility, generating continuous memory test patterns for exercising up to 16 million memory locations and

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the L290 can be configured with a wide variety of Teradyne-designed and IEEE-488 analog instruments. Interactive menu-oriented displays of instrument front panels allow easy instrument setup and live debugging of analog tests. Teradyne and IEEE-488 instruments connect to the unit under test through a six-wire analog matrix, and are controlled by a dedicated analog instrumentation processor.

In common with other members of the L200 board-tester family, the L290 provides an array of diagnostic aids. These include guided-probe analysis of nodal response at pattern rates up to 80 MHz. Using dual-threshold voltage comparison to ensure accuracy, the guided probe measures static and dynamic signal states in a specified time window. Again, the elimination of dead zones enhances accuracy and flexibility by allowing measurement of nodal response at any point in the pattern cycle.

The inaccessibility of a potted or sealed module's internal nodes imposes restrictions on the use of diagnostic tools, many of which depend on physical probing of the unit under test. Thus traditional functional diagnostics tools such as guided probes have to be supplemented with noninvasive techniques such as fault dictionaries.

The L290 fault dictionary consists of stored primary-output patterns or fault signatures, which reflect known fault conditions injected into a software model of the board or module during fault simulation using Teradyne's Lasar Version 6 simulator. By matching the responses of an actual failed unit with fault signatures stored in the dictionary, L290 system software helps isolate the source of a failure without probing.

The price of a typical L290 system configuration ranges between $800,000 and $3.2 million. First system deliveries will be in mid-1986. ☐

TERADYNE TAKES A TEAM APPROACH TO TEST DEVELOPMENT

When Teradyne Inc. set out to design a 40-MHz functional tester that can take on very large-scale-integration circuit modules with hundreds of input/output pins, it chose a team whose members were used to handling new ideas and working together on design and system decisions.

The core design team for the L290 consisted of 15 senior engineers whose collaboration at Teradyne's manufacturing systems division in Boston goes back nearly a decade. "The L290 is the third high-speed system architecture we've worked on together," notes Mike Baglino, engineering manager for the division. The earlier systems were the 5-MHz L135, introduced in 1978, and the 10-MHz L200, introduced in 1980.

The team's history of cooperative problem solving lends a continuity that Baglino believes is essential in an effort as multifaceted as the L290 project. "We each have the advantage of building on lessons—personal and organizational as well as technical—learned from earlier work together. It saves us having to reinvent a lot of wheels."

Still, there have been changes in how the team works, Baglino points out. One of the most obvious is that hardware engineers today enjoy an array of productivity tools they didn't have before. These, in turn, have produced another difference: "Software has become a much more people-intensive part of system design. One hardware designer sitting at an engineering work station using a schematic-capture package or our own Lasar simulator can crank out more work than a whole team could 5 or 10 years ago," says Baglino.

No tools of anywhere near equivalent power are available on the software side, however. So although hardware still eats up more dollars, software people now represent the majority of Teradyne's project team.

A significant part of the L290 team's software effort went into adapting the L200 tester family's system software—which today contains more than 1.5 million lines of code—from the earlier DEC PDP-11/44 tester's central processing unit to run on the MicroVax II-based L290.

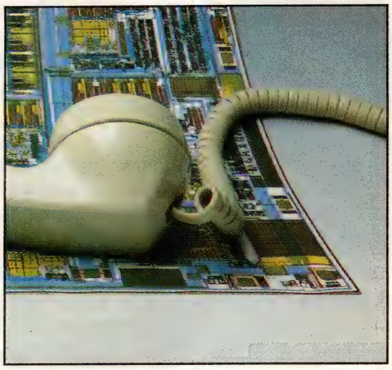
Nonetheless, the work produced its own reward. "We used to spend 50% of our time working around the limitations imposed by a 16-bit address space," reflects Baglino. "Now in the 32-bit VAX environment, it feels like there's nothing we can't do."

That has freed the L290's software engineers to concentrate on the niceties of easier-to-use programming and debugging features, and the more-efficient diagnostics tools needed for troubleshooting a sealed module. "These are the things that ensure that all this hardware capability we've been sweating over will actually get used effectively in the real world," Baglino says.

TEAM. The L290 project's 53 hardware and software engineers join marketing colleagues in front of their creation.

TRUE ONE-CHIP MODEM BLAZES DESIGN TRAIL

WITH IT, SIERRA CAN PROVIDE COMPLETE SYSTEM SOLUTION



Sierra Semiconductor Corp. is blazing a trail in 1,200-b/s modems. It is introducing a true single-chip modem that has all the circuitry necessary for processing telephone-line signals. With its companion controller chip, the modem slashes the cost of hooking a processor to a phone line yet adds new flexibility to the modem package. Sierra aims to open the way for many potentially high-volume 1,200-b/s modem applications, such as remote diagnostics or credit-card verification systems.

"We set out to provide a complete systems solution, not only for the modem functions, but also for the controller," says James V. Diller, president of the San Jose, Calif., company. "Up until now, if someone wanted to incorporate a 1,200-b/s modem in a system—whether it be a terminal, computer, or any system requiring remote access—two choices were available: either buy a complete modem or design one using chips from various manufacturers" (see story, p. 50).

Sierra supplies a modem and controller set that is compatible with all the communications software written for the Hayes-type modems—and keeps the price of the set below $35 in large volumes, compared with almost $70 for other one-chip modems that require considerable additional circuitry plus the companion controller. This chops away much of the time and expense usually associated with modem design. The chips were also designed by the two-year-old maker of custom and standard CMOS application-specific ICs for easy adaptation to other modem applications and for easy inclusion of custom features.

Sierra's SC11004 modem and its companion SC11007 controller make a Bell 212A or CCITT V.22 smart modem, complete with all the popular Hayes AT commands. All that has to be added is the data-access arrangement (DAA) for connection to the phone line. Required by the Federal Communications Commission to connect any piece of equipment to the public phone network, the DAA consists of an isolation transformer, a relay for disconnecting the modem from the line, a ring detector, and high-voltage surge protectors. The modem chip even includes the two- to four-wire hybrid circuit, simplifying the interface to a DAA.

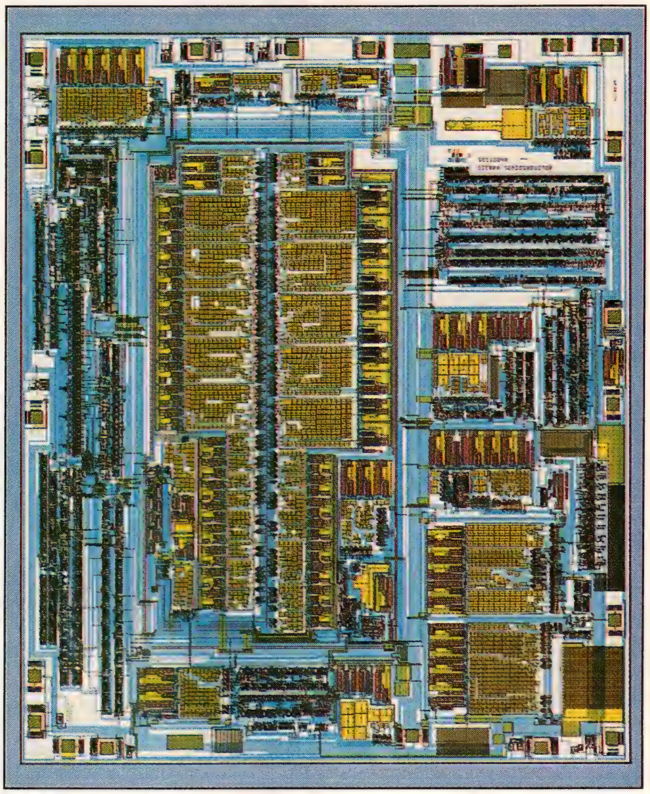
Diller says that going the design route is complicated, even with other so-called single-chip modems. "Some don't include V.22 operation; others require an external DTMF [dual-tone multiple-frequency] generator or an external 300-b/s modem chip for the low-speed fallback mode. And none include the two- to four-wire hybrid circuit needed to connect to the phone line. Writing the microcode for the handshaking sequence is not trivial, and writing code for the Hayes command set to make a smart modem is a major task most systems companies don't want to undertake. We've done it for them."

Sierra is counting on its single-chip modem to open up new applications, so modem sales could rise above current estimates. For example, "vending machines will be able to signal 'come empty me,'" suggests Steve Fields, who is Sierra's director of product marketing.

The market for 1,200-b/s modems used with data terminals and personal computers should be about 1.2 million units in 1985, growing to about 2.7 million units in 1989, according to a recent report from Dataquest Inc., the San Jose, Calif., research company. If Sierra projections are correct, the consumption forecast by Dataquest will be supplemented by many more applications, such as remote diagnostics and applications using 300-b/s modems that will upgrade to 1,200 b/s.

The 230-by-275-mm SC11004 is built with Sierra's 3-μm CMOS double-polysilicon process that allows analog and digital functions to be combined on the same chip (Fig. 1). It handles all the signal-processing functions needed for a full-duplex modem—including 300-b/s frequency-shift-keying and 1,200-b/s phase-shift-keying modulators and demodulators. The 300-b/s mode is for fallback use, when noise on the line or other conditions prevent 1,200-b/s transmission. The chip operates in either synchronous or asynchronous modes and can handle 8-, 9-, 10-, or 11-bit words. It also includes capabilities for call-progress monitoring and for generating DTMF signaling and V.22 guard tones. The SC11004 also includes analog loopback and remote digital loopback functions for self-testing.

The SC11004, like all mo-



1. LEADING EDGE. A one-chip modem loaded with features such as the two- to four-wire hybrid circuit could put Sierra Semiconductor ahead of its competition in the race for new modem applications.

dems, needs a controller to determine the mode of operation, initiate the call to the remote modem (either pulse or tone dialing), set up the handshaking sequence with the remote modem, monitor the call progress tones on the line (ringing, busy, answer tone, and voice), and switch into the data mode. A simple four-line serial data interface was designed for the SC11004, enabling it to work with just about any 8-bit microcontroller or microprocessor.

The 220-by-126-mm SC11007 modem controller, implemented in Sierra's 2-μm CMOS process, was designed to handle all the modem-control functions as well as the interface to a system bus. Besides including an 8-bit microprocessor, 8-K by 8 bits of read-only memory, and 128 by 8 bits of random-access memory, it also contains the functions of an 8250B universal asynchronous receiver/transmitter, greatly simplifying the interface to a parallel system bus, such as the one used in IBM Corp.'s Personal Computer.

Another version of the controller, the SC11008, is intended for RS-232-C applications. It contains the same processor, memory and UART as the SC11007 and has the same interface to the modem chip. The UART is turned around so that serial data from the RS-232-C port is converted to parallel data handled by the internal processor. Both the modem and either controller are available in a 24-pin dual in-line package or in a 28-lead plastic chip carrier with J leads for surface-mounted applications.

The chip set is not limited to implementing a Hayes-type smart modem. For example, only about 6-K bytes of the SC11007's ROM is used for the handshaking and smart-modem code, leaving 2-K bytes for additional features such as custom calling. Because the controller is ROM-programmable, any command set, not just the Hayes AT set, can be implemented.

Major sections of the SC11004 modem (Fig. 2) are a transmitter, a receiver, low- and high-band filters, a two-to-four-wire hybrid, tone generators, and interface logic. It also contains an energy detector used for detecting the carrier and for call-progress monitoring, as well as an audio output for monitoring the line. The SC11004 modem requires ±5 V.

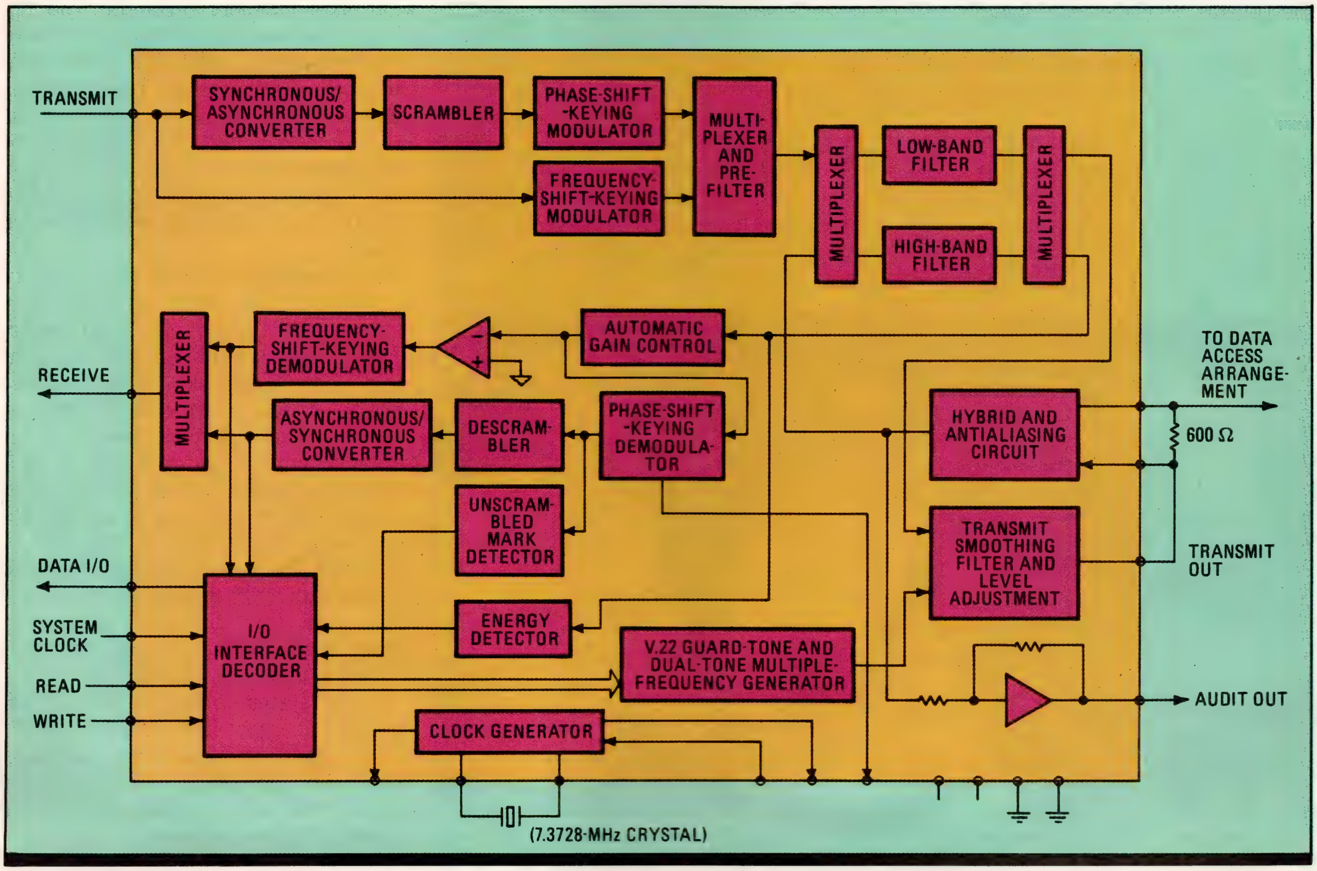
The transmitter section consists of an asynchronous/synchronous converter, scrambler, phase-shift-keying modulator and frequency-shift-keying modulator. In the 1,200-b/s mode, the PSK modulator is connected to the filter. In the 300-b/s mode, the FSK modulator is connected to the filter. Because data terminals and computers may not have the 0.01% timing accuracy required for 1,200-b/s transmission, timing correction on the incoming data stream must be made. The asynchronous/synchronous converter accepts asynchronous serial data clocked at a rate between 1,200 Hz + 1%, –2.5%. It puts out serial data at a fixed rate of 1,200 Hz ±0.01% derived from the master clock oscillator. The output of the converter is applied to the scrambler.

The scrambler is a 17-bit shift register used to randomize data so that the energy of the modulated carrier is spread over the band of interest—either the high band centered at 2,400 Hz or the low band, centered at 1,200 Hz. Output of the scrambler, in the form of a dibit, is applied to the PSK modulator. For 300-b/s operation, the FSK modulator is used. Its output is applied to the appropriate filter when the low-speed mode of the operation is selected.

The filter section consists of low-band (1,200 Hz) and high-band (2,400 Hz) filters and half-channel compromise-amplitude equalizers and group-delay equalizers. For V.22 applications, a notch filter can be programmed for either 550 or 1,800 Hz. In the call-progress monitor mode, the low-band filter is scaled down by a factor of 2.5 to center it over a frequency range of 300 to 660 Hz. Thus, during call establishment in the originate mode, call-progress tones can be monitored through the scaled low-band filter and the modem answer tone or voice can be monitored through the unscaled high-band filter.

The receiver section consists of an energy detector, auto-

2. BLOCK BUSTER. The Sierra 300-/1,200-b/s full-duplex modem is a true one-chip design, built in 3-μm CMOS and measuring 230 by 275 mm.


TRANSMIT
SYNCHRONOUS/ ASYNCHRONOUS CONVERTER
SCRAMBLER
PHASE-SHIFT-KEYING MODULATOR
FREQUENCY-SHIFT-KEYING MODULATOR
MULTI-PLEXER AND PRE-FILTER
MULTIPLEXER
LOW-BAND FILTER
HIGH-BAND FILTER
MULTIPLEXER
RECEIVE
MULTIPLEXER
FREQUENCY-SHIFT-KEYING DEMODULATOR
AUTOMATIC GAIN CONTROL
ASYNCHRONOUS/ SYNCHRONOUS CONVERTER
DESCRAMBLER
PHASE-SHIFT-KEYING DEMODULATOR
UNSCRAMBLED MARK DETECTOR
TO DATA ACCESS ARRANGEMENT
HYBRID AND ANTIALIASING CIRCUIT
600 Ω
TRANSMIT SMOOTHING FILTER AND LEVEL ADJUSTMENT
TRANSMIT OUT
DATA I/O
SYSTEM CLOCK
READ
WRITE
I/O INTERFACE DECODER
ENERGY DETECTOR
V.22 GUARD-TONE AND DUAL-TONE MULTIPLE-FREQUENCY GENERATOR
AUDIT OUT
CLOCK GENERATOR
(7.3728-MHz CRYSTAL)

matic gain control, PSK and FSK demodulators, descrambler, and synchronous/asynchronous converter.

The received signal is routed through the appropriate bandpass filter and applied to both the energy detector and AGC circuit. The energy detector is based on a peak detection algorithm. The AGC circuit is a programmable-gain amplifier that covers a range of 28 dB in seven steps, converting the received signal to the desired level.

The PSK demodulator uses a coherent demodulation technique to produce a dibit that is passed to a descrambler similar in design to the scrambler. In the asychronous mode, data from the descrambler is applied to the synchronous/asynchronous converter to reconstruct the originally transmitted asynchronous data.

The output of the converter, along with the output of the frequency-shift-keying demodulator, is applied to a multiplexer. Then the multiplexer selects the appropriate output, depending on the operating speed, and sends out received data on the receive-data pin.

AN ON-CHIP HYBRID CIRCUIT

Sierra has one of the few single-chip modems offering an on-board equivalent of the two- to four-wire hybrid circuit, DTMF generator, and programmable audio output. The hybrid takes the separate transmit and receive signals used in a full-duplex modem and combines them into one signal that goes over the phone line.

The signal on the phone line is the sum of the transmit and receive signals. The hybrid subtracts the transmitted signal from the signal on the line to form the received signal by matching the hybrid impedance as closely as possible to the telephone line to produce only the received signal.

The tone-generator section consists of a DTMF generator and a V.22 guard-tone generator. The DTMF generator produces all of the tones corresponding to digits 0 through 9 and the * and # keys on the standard telephone key pad. The V.22 guard-tone generator produces either 550 or 1,800 Hz.

To drive a speaker for line monitoring, the chip has an audio output with four levels of attenuation—no attenuation, 6- and 12-dB attenuation, and squelch. Its output drives an external audio amplifier (LM386 type), which can be linked to drive a low-impedance speaker. The output can directly drive a high-impedance transducer, but the volume level will be low.

Besides the four-line interface for the SC11004 modem, the SC11007 controller has an 8-bit data port, three address lines, a chip-select input, an interrupt line, and the data-output-strobe (DOST) and data-input-strobe (DIST) control lines found in the 8250B UART. It also has control lines for ring indication, the off-hook relay and a data/voice relay; these three lines connect to the DAA.

In the SC11008, the 8-bit port becomes the switch input lines and the address, chip-select, DIST, and DOST lines become the six lines for the RS-232-C interface. Internally, all of these lines are treated as programmable input/output ports under software control—so the main difference between the two versions of the controller is the ROM code.

The SC11007 and SC11008 are truly ASIC controllers—they are designed to control a modem or other peripheral that operates at anywhere from a moderately slow data rate up to 1,200 b/s. What's unique about the SC11007, for example, is that it allows a slow peripheral to interface to a high-speed bus without slowing down the main processor. This is done through the UART interface and the on-chip registers, which look somewhat like dual-port registers. The on-board processor can write to and read from them at will, while the on-chip controller can do the same. The controller was designed this way because most communications software has to have unrestrained access to the UART registers. To make the SC11007 compatible with this software, the registers were included.

The processor monitors the registers to determine the mode of operation—command mode or data mode. At power-up it is automatically put in the command mode and it looks for instructions. Once the carrier is detected, it goes into the data mode and stays there until an escape sequence is entered. Just as in a Hayes-type modem, the escape sequence is three plus signs (+++) in the default mode, but it can be changed in software.) The processor contains an 8-bit data path and can execute 19 instructions with five different addressing modes: direct, indirect, immediate, register direct, and register indirect.

To the system bus, the SC11007/08 looks and acts just like an 8250B UART. All of the communications software written for this UART will work with the SC11007 and SC11008. The Sierra chip set is truly a Hayes-type modem in two chips. ☐

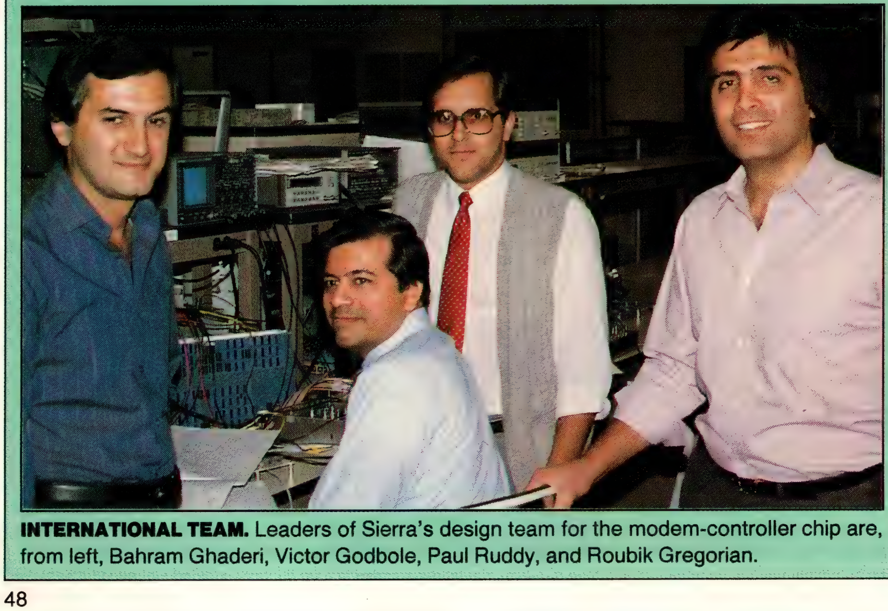
SIERRA'S DESIGN TEAM HAS MIDEAST FLAVOR

Known worldwide for his contributions to switched-capacitor-filter design, Roubik Gregorian is Sierra's director of analog design. He received BS and MS degrees in electrical engineering from the University of Teheran, Iran, in 1973. Coming to the U. S., he attended the University of California at Los Angeles and received an MS in 1975 and a PhD two years later.

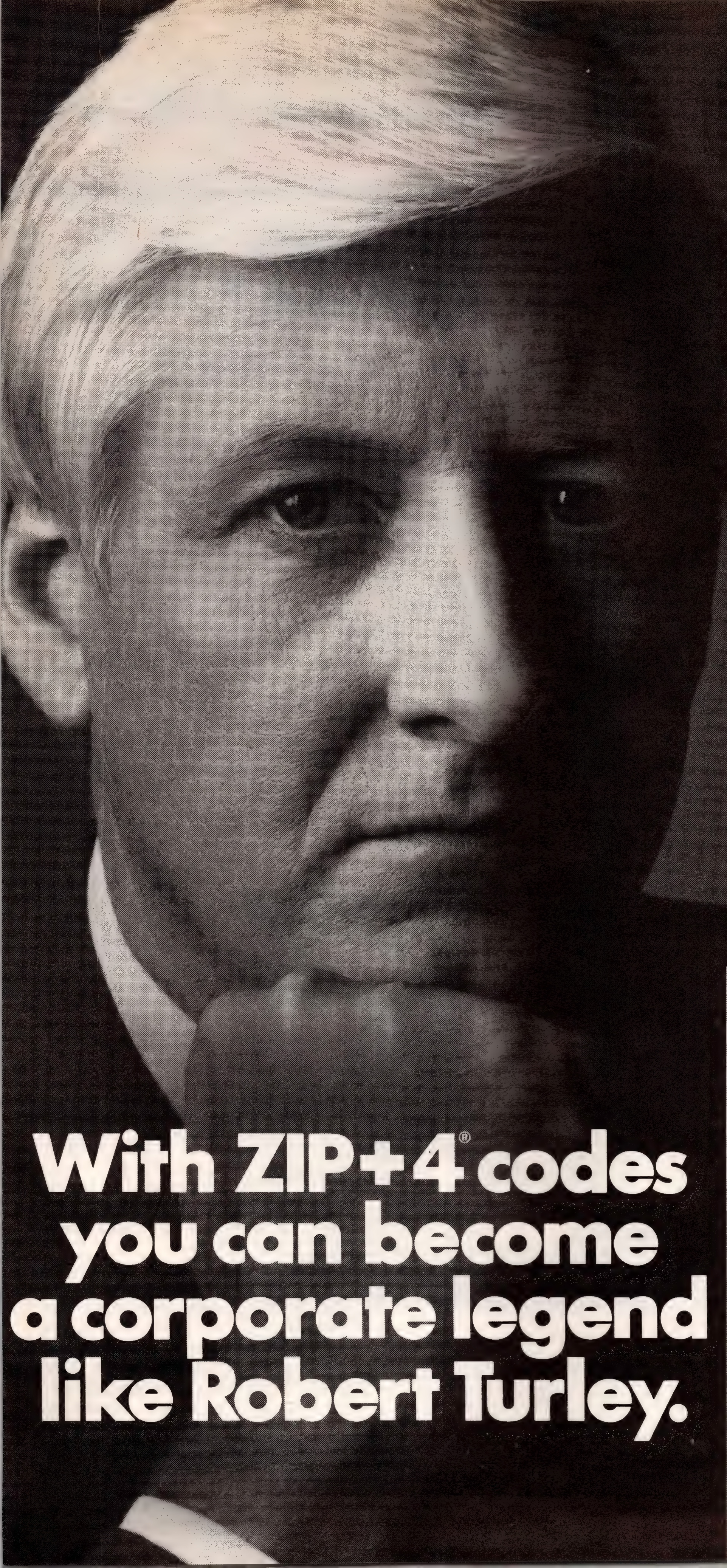
Gregorian designed the SC11004 modem chip with Bahram Ghaderi, senior analog designer. Gahderi took the same academic track, receiving his BS and MS in electrical engineering from the University of Teheran in 1975, and his MS and PhD from UCLA in 1978 and 1981.

The designer of the SC11007 controller is Paul Ruddy, a staff engineer in the Semicustom Group. A native Californian, he graduated from Stanford University in 1978 with a BSEE. He attends the University of California at Santa Clara Graduate School of Business.

Victor Godbole, the director of applications at Sierra, developed the control code for the SC11004 modem and wrote the Hayes-compatible command software for the SC11007 modem controller. He holds a B. Tech. from the India Institute of Technology, Bombay, and an MS from Oklahoma State University.



INTERNATIONAL TEAM. Leaders of Sierra's design team for the modem-controller chip are, from left, Bahram Ghaderi, Victor Godbole, Paul Ruddy, and Roubik Gregorian.



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PROBING THE NEWS

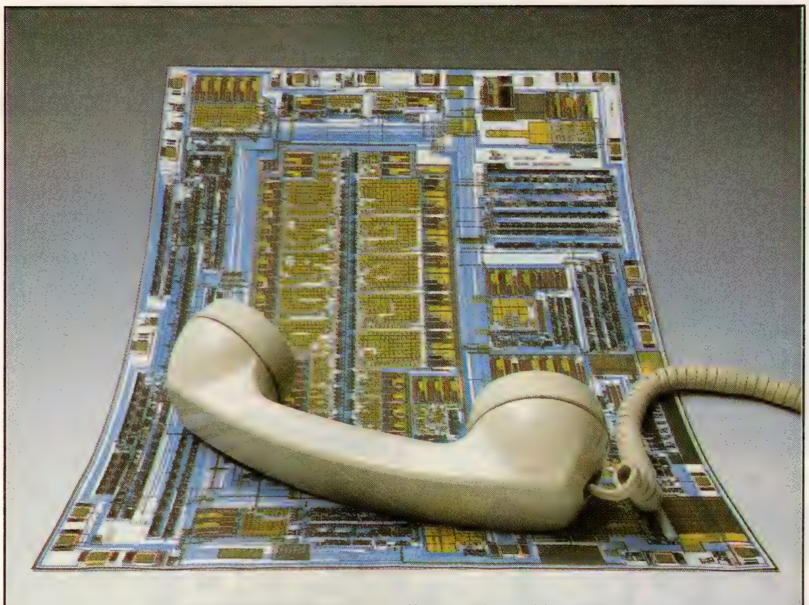
IS TROUBLE COMING FOR MODEM MAKERS?

ONE-CHIPPERS THREATEN TO STEAL THEIR THUNDER

by Tom Manuel

Modem makers struck it rich when the market exploded for peripheral gear that bolsters the utility of computers. But with a major drive by chip makers to develop single-chip modem circuits, the modem will no longer need to be peripheral. Very large-scale integrated circuits will make it easy and inexpensive for equipment makers to build modems into their personal computers, terminals, and special-purpose products. That means trouble is not far off for makers of stand-alone modems.

Once a modem can be added to a product simply by plugging in a couple of chips, equipment manufacturers inevitably will choose to enhance many of their products by including a built-in ability to communicate with the outside world. For example, major personal computer vendors such as IBM, Compaq, and Apple could start to embed modems in their computers as standard equipment—a trend that would severely cut back the market for traditional add-on modems.



Higher integration makes them easier to build into products

"There is no reason in the world why modems cannot be installed in the backplane of the machine" now that VLSI modems are becoming available, says Kent Nutt, telecommunications industry analyst at Dataquest Inc., San Jose, Calif. And this is a definite trend, he adds, but it is not happening as quickly as it could.

The cost of VLSI modem chips is still too high for mass use—higher than that of less-integrated alternatives. A great many modem chips announced earlier this year are just now becoming available (see chart). Their cost will go down as more are produced, but at the moment, low cost is little more than a promise. But a new contender, Sierra Semiconductor Corp., is out to change things. The San Jose, Calif., company claims its new single-chip modem, along with a controller, will cost less than $35 in quantity and can be simply plugged into a product without any additional design work (see p. 46).

Chips like those from Sierra as well as Advanced Micro Devices Inc. could make major inroads in markets where a product requires a dial-up modem so that it can be simply plugged into a telephone jack. But there are several reasons why the traditional modem products will not disappear immediately. For one thing, there is a large number of existing personal computers in use that cannot be outfitted with the new single-chip modems. The users of many of these will need box- or board-level modems as their applications evolve.

And that installed base of computers requiring add-ons will continue to grow. "There are still a lot of personal computers being made that don't allow for the integration of modems," says Nutt. It will probably not be until 1988 or even 1989 that a significant portion—greater than 30%—of the mainline personal computers being built will have integral modems, he says.

In addition, growth of the overall market for modems has continued apace even through the current computer-industry slump. The need for computers and other intelligent devices to communicate will continue to spawn growth for modems of all kinds. And the total demand will be enough to keep the color in the cheeks of the traditional modem business for a while.

It is difficult to settle on a single figure to portray that progress graphically. Dataquest, in its equipment-market forecasts, now splits up the market and classifies modems by product application. But an accurate idea of what is happening can be gained from two of Dataquest's classes.

The one called data-terminal modems consists of modems that can be described as primarily synchronous, handling 300 to 9,600 bits per second, and connected mostly to leased lines. Dataquest is projecting the dollar value of data-terminal-modem shipments will

FULL-DUPLEX MODEM CHIPS FOR 1,200 b/s HIT THE MARKET

Maker Part(s)	212A with 300-b/s fallback	V.22	Filters on chip	Dual-tone multiple-frequency generator	Controller chip complete with smart modem software	On-chip hybrid circuits to combine transmit and receive signals	Production and availability
Advanced Micro Devices **Am79C12**	yes	no	yes	yes	no	yes	samples first quarter 1986
Fairchild Camera & Instrument **μA 212A**	yes	no	yes	no	no	no	Nov. 1985
Gould AMI chip set **S 35213 modem** **S 35122 A filter**	yes	yes	separate chip S 35122 A	no	no	no	now
Micro Power Systems MP 212 A two-chip set **MP 7246 modem** **MP 7247 filter**	yes	yes	separate chip MP 7247	yes	no	no	now
Rockwell International **R 212 DP (three chips)**	yes	yes	yes	yes	no	no	now
Sierra Semiconductor **SC 11004 modem** **SC 1107 controller**	yes	yes	yes	yes	yes	yes	samples first quarter 1986
Silicon Systems **K 212A** **K 222**	yes no	no yes	yes	yes	no	no	samples end of Nov.
Texas Instruments **TMS 99533** **TMS 99542**	no	yes	yes	no	no	no	now

SOURCE: *ELECTRONICS*

grow at a compound annual rate of 12.5% over the next four years—rising from $894.8 million in 1985 to $1.43 billion in 1989.

Personal computer modems, another major Dataquest classification, are primarily asynchronous and handle 300 to 9,600 b/s. They are connected exclusively to dial-up lines. The company forecasts that shipments will grow much faster than for the data-terminals—and will hit a 49.3% compound annual rate, taking sales from $258.5 million in 1985 to $1.28 billion in 1989.

Another reason for such growth is the axiom that new electronics products tend to expand market boundaries rather than merely add competitors. There are ways that the new single-chip modems now coming to market can enhance the board and box products, rather than hurt them.

OPPORTUNITIES. The box makers could very well incorporate the new chips into their stand-alone products, taking advantage of the chips' low power requirements and small size to make room for more functions in their new products. As Garry Betty, vice president of marketing and sales for Hayes Microcomputer Products Inc., Norcross, Ga., sees it, "There will be plenty of opportunities for modem makers to use IC advances to enhance and add features to their products.

"We see modem and digital-signal-processing chip developments as a very positive opportunity," Betty comments. "We have seen just the tip of the iceberg as far as what is to come in chip developments, and we at Hayes are looking forward to using whatever developments make sense for the products we are planning."

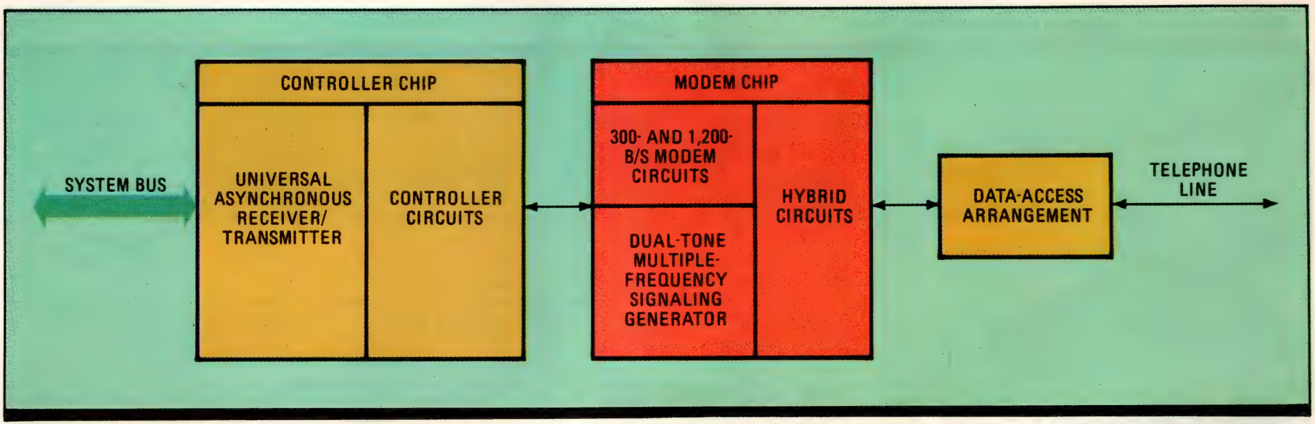
Equally important, the new single-chip modems do not have standards, which will slow the pace at which they turn up embedded in computers.

Standards are the bugaboo that confronts virtually every advance in the electronics industry. The major personal computer makers will take their time deciding when to integrate modems into their standard products because they will have to settle on a single speed and protocol, but there is no one combination that is clearly so attractive that the big equipment makers will rush headlong to embrace it.

Modem ICs with speeds of 300 b/s have been available for some time. They have even been embedded in some portable computers. But makers of stand-alone modems have moved up to 1,200-b/s models, and these peripherals have sold well to personal computer users—1,200-b/s modems are now the most popular for use with personal computers. Now, as 1,200-b/s modem chips reach the market, stand-alone-modem suppliers are moving up to 2,400-b/s models.

As the speed increases, protocols become more complex; the modems must have more sophisticated procedures to deal with the variability of dial-up phone-line quality. At 300 b/s, for example, a modem has few functions to handle besides the basic modulation and demodulation of the data stream. At 1,200 b/s, the handshaking is more complex and the modem requires a controller.

Only two of the several VLSI product offerings so far have all the modem functions on one chip—AMD's Am79C12 and Sierra's SC11004. The others are either two- or three-chip sets or require such additional circuits as the hybrid. In addition, Sierra's is the only one that has a complete modem on a chip with both the U. S. 212A and European V.22 standards on the same chip. Sierra is also the only vendor that offers a companion controller chip that comes com-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THE WORKS. When a data-access arrangement is added to Sierra's two chips, the controller and the modem, a complete modem emerges.

plete with smart modem software.

Most of the multichip sets are available now at a range of prices. The more highly integrated single-chippers will not be available until early next year, and then only in sample quantities. The day will come, though, when enough single-chip modems arrive on the market to drive the price down and a standard settles out of the confusion. At that point, the faceoff between traditional modem makers and the single-chippers will begin in earnest.

NEW HOMES. Besides personal computers, there are other devices for which the market is growing and into which the new wave of modem chips will be going—hand-held terminals, laptop and transportable computers, remote data-capturing devices, vending machines, and charge-authorization terminals, to name a few of the more common ones. These markets may be closed to the board- and box-modem makers, because space and power are at such a premium in these products that no one making them will consider adding a whole board, much less a box, when two little chips will do.

A good example of what two little chips can do is the new Sierra product. By putting all the required modem functions on one chip (see diagram), called the SC11004, and all the controller functions with firmware on another, the SC11007, Sierra is making it very easy for equipment makers to add modems to their products. The modem chip houses a complete AT&T Bell 212A standard modem—a dial-up 1,200-b/s modem, which automatically drops to 300 b/s when the line quality is too poor for accurate transmission at the higher speed—and an International Telegraph and Telephone Consultative Committee (CCITT) V.22 standard modem. This chip also has a dual-tone multifrequency tone generator for dialing and the hybrid circuits to combine the transmit and recieve signals for interconnection to the telephone line.

"Our solution is to provide a smart modem complete with software in just two chips—a true single-chip modem and a single-chip controller with a universal asynchronous receiver/transmitter," which interfaces the controller to the computer's bus, says Steve Fields, Sierra's director of product marketing.

"The customer gets a complete CMOS low-power modem system that will work with all of the communications software written for the Hayes-type modems." The reference is to Hayes Microcomputer Products, the leading maker of modems for personal computers and pioneer of the smart-modem concept. The easy-to-use Hayes Smartmodem has become a de facto industry standard.

Box-modem makers still have tricks in their bag

A user does not have to write any controller code for the Sierra chips, because the code is provided in programmable read-only memory. "The average customer, like the guy who wants to build a 212A-compatible modem into his personal computer, does not have to do anything except plug in the two chips," says Fields. But an equipment maker can specify a different code for the ROM and deliver unique modem features in the company's products.

New uses that open up for embedded modems with these VLSI-chip sets are quite varied. For example, vending machines could become a big market. They could be plugged into telephone outlets to call up a supervisory computer whenever the machines required service, whether they needed to be refilled with merchandise or relieved of cash.

Sierra's Fields suggests another emerging market—pay telephones. Now that anyone can own a pay phone and charge any rate, pay phones could have programmable memory for rates. With a built-in modem, the rates could be updated from a central computer. The telephone could also notify its supervisor when the cash box was getting full.

The myriad of credit-card-verification and -authorization terminals could be upgraded to benefit from faster modem chips. With faster transmission, the amount of data transmitted for each transaction could be increased without slowing down the transaction. This opens the door to better security—for example, detecting more stolen cards, because more information can be transmitted back and forth.

HEALTH CARE. Another possible application is adding remote diagnostic ports to a product, which might turn out to be a significant reason to build a modem into a personal computer or work station. Currently, most larger computers—mainframes, minicomputers, and the more expensive work stations—are linked to the dial-up telephone network for remote diagnostics so users can fix many problems by swapping good components for bad.

Personal computers used in offices may be the last to be equipped with remote diagnostic capabilities because they are now serviced by the same on-site service people who work on a customer's other equipment. But with the promise of easily adding inexpensive, embedded 1,200- or 2,400-b/s modems, remote diagnostic capability could migrate quickly to more isolated microcomputers—in the factory, on the farm, in the oil fields, or in the home, for example. When not being used for diagnostics, the built-in modem could be used for other data communications.

Even before the single-chip modem's star rises, though, it is possible to predict its waning. The embedded modem may well be the long-term successor to board- and box-level modems, but there is a longer term to contend with, when other new technologies reach their apex. Local networks, digital private branch exchanges, and the coming integrated services digital network are on the rise. Users will not need modems to connect to any of these. □

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MAP MOVES INTO FACTORY, BUT FACES LONG HAUL

ONE PROBLEM MAY BE COMPATIBILITY OF MAP VENDORS' PRODUCTS

by Wesley R. Iversen

DETROIT

The Manufacturing Automation Protocol championed by General Motors Corp. is making startling progress toward the automaker's goal of a standard for multivendor factory communications. "People can't believe that so much has been accomplished in such a short time," says Michael A. Kaminski, GM's MAP program manager. "I've even heard one guy compare this whole effort to the Manhattan project to develop the atomic bomb."

Yet backers of the standard realize they still have a long way to go if MAP is to become a true industry standard. The scheme's milestone demonstration at this week's Autofact '85 show in Detroit and a number of factory MAP installations planned for early next year are only the beginning, they say. Backers point out, for example, that in order to boost MAP into the the real-time world, the standard must allow carrier-band subnets that can handle real-time tasks, but still attach to the MAP broadband net, which is essentially a backbone for communications.

In addition, there are still real questions in the minds of potential MAP users and vendors alike about the true compatibility of MAP products supplied by different vendors. As a result, GM, MAP users, and other organizations involved are now pushing harder to develop the complex tools necessary to test equipment for MAP compliance.

FAST PACE. GM's aggressive backing of MAP has significantly accelerated the snail-like pace at which standards are traditionally set, says John F. Heafner, chief of the Systems and Networking Architecture Division for the National Bureau of Standards, Gaithersburg, Md. "If GM hadn't stepped in, it would have probably been another four or five years before we would have seen OSI-based networks installed." His reference is to the International Organization for Standardization's seven-layer open-systems interconnection model, on which MAP is based.

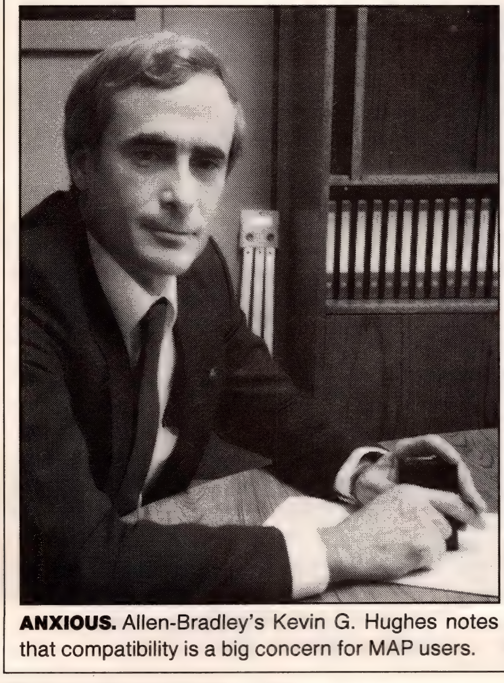
As it stands, companies such as GM, Deere, and Boeing will soon install limited networks based on MAP 2.1—the scheme's latest version. Moreover, very large-scale integrated circuits are emerging to handle the IEEE-802.4 token-passing functions needed for MAP's layers 1 and 2. By early 1986, factory-automation gear claimed to be compatible with MAP 2.1 could flood the market. About 25 vendors will show MAP products at Autofact.

Despite this progress, the ultimate success of the MAP standard is far from assured. "We don't believe today there is interoperability among the different MAP vendors," says Kevin G. Hughes, manager of Allen-Bradley Co.'s Area Communications Products Systems Division in Highland Heights, Ohio. It's a "very grave concern in the MAP community."

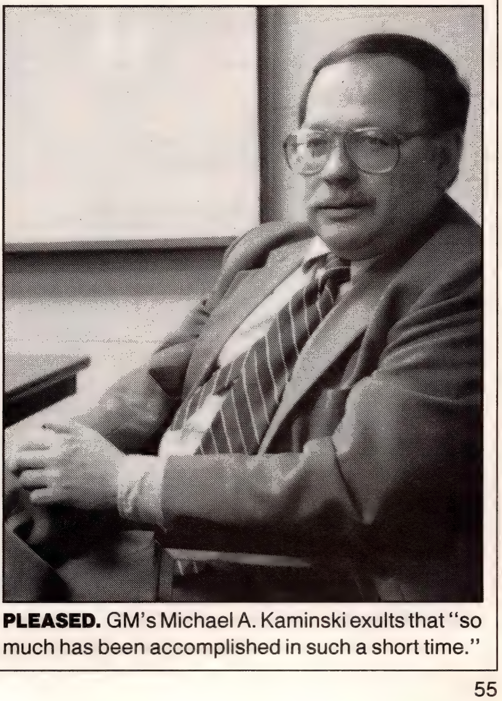
As with any emerging standard, there is room for differing interpretations of the MAP specifications by vendors, meaning that systems can be built that may conform to the standard and still not work with other "standard" products. But the crux of the problem is the current lack of adequate tools for MAP product certification and conformance testing.

"Testing is *the* major concern right now," says Wayne Hanna, an organizer and former chairman of the 2½-year-old MAP users' group, which now counts more than 250 companies as members. "If we can't make this equipment interoperable so we can plug it all into the same network, then we've lost the whole benefit of the exercise," Hanna declares. He points to the Ethernet marketplace, where an estimated 200 vendors offer local-area-network products that are largely incompatible with one another even though they conform to the IEEE-802.3 standard. "The same thing could happen with MAP," Hanna warns, unless the user community "puts some teeth" into its demands that MAP boxes from one vendor must be able to talk to boxes supplied by other vendors.

Hanna says MAP prices of about $2,000 per port must drop to $500 to $800 or else users will stay with proprietary nets costing $300 to $400. Such a price drop won't come without volume, however. And "if there's a problem



ANXIOUS. Allen-Bradley's Kevin G. Hughes notes that compatibility is a big concern for MAP users.



PLEASED. GM's Michael A. Kaminski exults that "so much has been accomplished in such a short time."

[with MAP compatibility], users will balk," notes David C. Scott, manager of factory automation and communication at Deere & Co., Moline, Ill.

The industry is attacking the problem on a widening front, however. Work to develop MAP test equipment is under way at many places, including GM, the NBS, and the International Technology Institute, a nonproft firm in Ann Arbor, Mich. The ITI, in fact, in September became the first organization to launch an independent conformance-testing service for MAP products. ITI has commercial tests available for four of the seven layers and three sublayers in the MAP architecture and expects to have the remainder available by early next year, says Andy McMillan, manager of its Network Evaluation and Test Center.

MORE FLEXIBLE. The ITI tools are based on what McMillan calls a second-generation technique that uses a programmable tool for testing MAP protocols. This differs from the earlier technique in which each layer is tested by comparing it to a piece of reference software that includes an actual implementation of the protocol layer under test. With the new technique, a programmable tool is used that can encode both correct and incorrect data sequences of the protocol under test. This allows the user more flexibility and control over the tests. The current method overcomes difficulties with the earlier reference testing approach, which sometimes fails to indicate problems involving interaction of the layer under test with the reference implementation, he says.

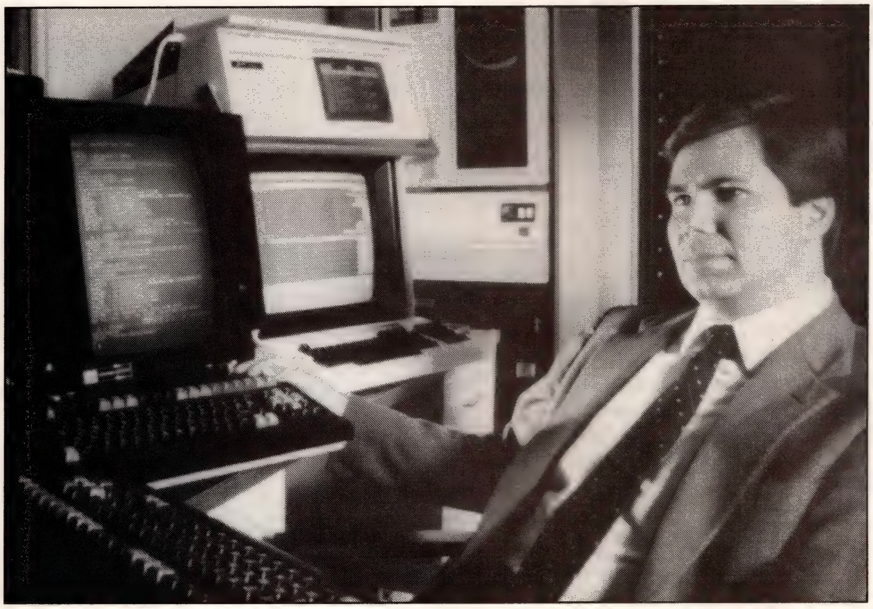
Like others, however, McMillan concedes that current test systems cannot yet check out MAP equipment adequately for all the conditions that may be encountered in a real-world network. "There's a monumental task ahead to figure out how to test this equipment in a black-box situation, where you can't get at the protocol itself because it's embedded in the system," says Maris Graube, chairman of the Institute of Electrical and Electronics Engineers' 802 local-net committee and an avid supporter of MAP [*Electronics*, Oct. 21, 1985, p. 32].

For its part, GM is fostering development of test facilities similar to ITI's in Canada, England, France, Germany, and Japan, says Kaminski. There are also several proposals for consortiums, funded by users and vendors, to support the development of MAP test tools, says Heafner. Under one plan, Haefner's NBS lab would be spun off as a private operation known as the Open Systems Institute to develop tools and test MAP.

The NBS plans in March to launch a globally distributed network that is designed to be a testbed for MAP vendors and users. Called OSInet, it will rely on X.25 communication links for cooperative development of MAP test systems, testing of MAP prototypes and products, and to provide vendors with a MAP product demonstration vehicle. Fifteen organizations—including AT&T, Boeing Computer Services, Digital Equipment, GM, Hewlett-Packard, and IBM—have already agreed to take part. Heafner expects 100 companies to be using the network by the end of 1986.

IMPETUS. One vehicle that has helped speed development of MAP test tools was the deadline for this week's MAP exhibit at Autofact, which promises to be the most dramatic demonstration yet of MAP's potential. "The Autofact demonstration definitely speeded up test tool development, since it provided a deadline for having some test capabilities for all of the protocols being used," says ITI's McMillan. MAP demonstration booths sponsored by GM and Boeing Computer Services will cover nearly a quarter acre of exhibit space.

If all goes as planned, showgoers will see equipment from different vendors tied together using two MAP-802.4 factory-floor nets and a manufacturing-office network known as TOP (for Technical Office Protocol). Developed under Boeing sponsorship, TOP, like MAP, is based on the seven-layer OSI model. Unlike MAP, TOP relies on an Ethernet-type IEEE-802.3 scheme for its bottom two layers. Another Autofact link will tie the networks on the exhibit floor by X.25 communication lines to another MAP net at GM's Technical Center in nearby Warren, Mich. ☐



FRONTRUNNER. The International Technology Institute's test-lab head Andy McMillan says ITI was the first to launch an independent conformance-testing service for MAP products.

MAP PRODUCTS STAR AT AUTOFACT

The Manufacturing Automation Protocol, like the International Organization for Standardization's open-systems interconnection reference model on which it is based, consists of seven layers. Products for three levels are bowing this week at Autofact. These levels—4, 5, and 7—transfer large amounts of data for non-real-time processes.

Twenty-five vendors, among them Intel Corp. and Motorola Inc., will show interface connectors conforming to the MAP architecture mandated by the following four upper-level protocols:

- CASE (common application service elements), for entering MAP from the top—for example, putting inventory requirements into the system.
- FTAM (file transfer access methods), for transferring a data base from a work-cell controller to a robot or numerical controller.
- MMFS (manufacturing message format service), for moving instructions from a work-cell controller to a robot.
- NMDS (network management directory services), for compiling statistical information.

The Technical Office Protocol applies the same architecture to office automation as MAP does to the factory. The MAP/TOP Steering Committee, which will meet at Autofact, seeks to integrate these protocols into common hardware interfaces that can transfer data between management and production applications. Boeing Co. is the prime mover behind TOP, which is based on the IEEE-802.3 collision-detection Ethernet network. MAP is a token-passing 802.4-based network. *–David M. Weber*

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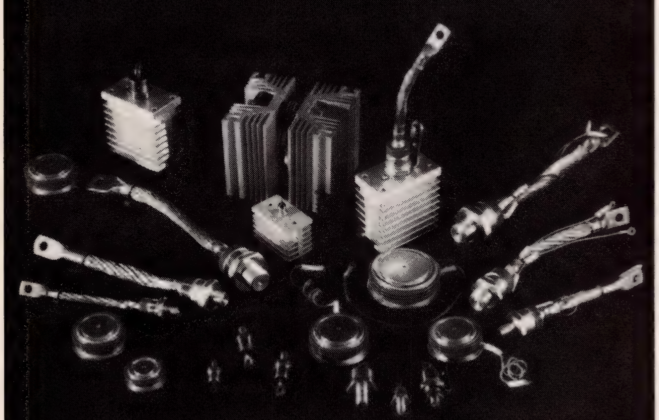

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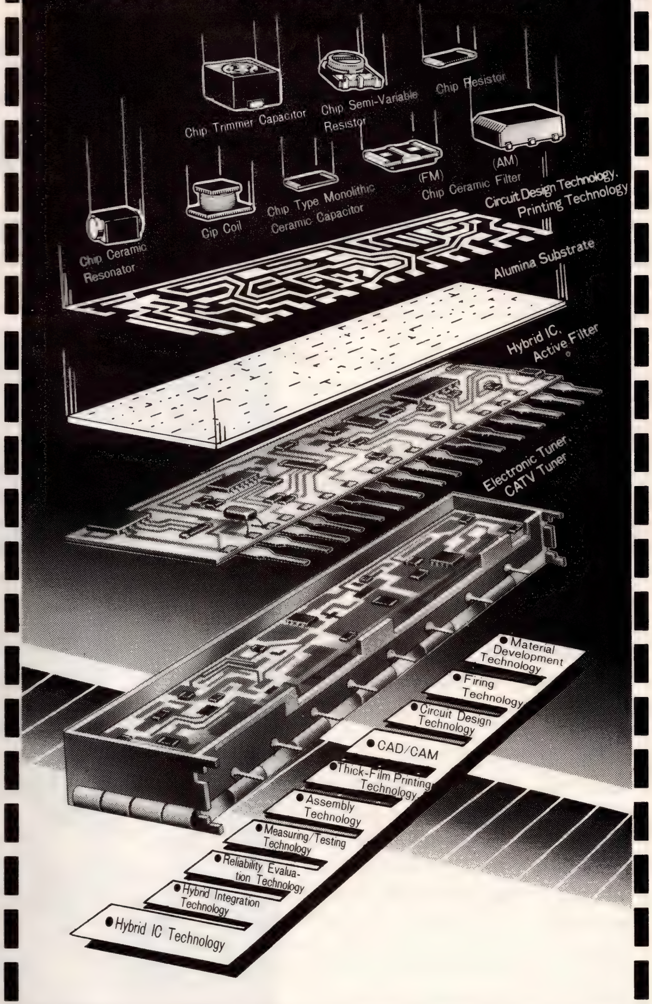
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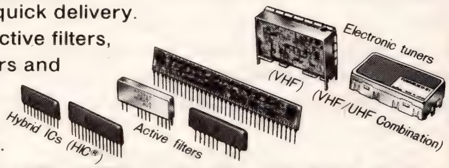

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EUROPEAN COMPONENTS: HAPPIER DAYS AHEAD?

INDUSTRY HEADS FOR COMPOSANTS CONVINCED THE WORST IS OVER

by Robert T. Gallagher

WATCHFUL. Composants means major trends, so it draws the likes of French prime minister Laurent Fabius, right, and RTC La Radiotechnique Compélec president Jacques Bouyer.

PARIS

By almost any measure, the European semiconductor market is in a catastrophic state. Book-to-bill ratios have hovered around 0.5 all year, stocks are still relatively high in the warehouses of both components makers and their customers, and the total European market will contract somewhat this year. But a growing number of industry insiders believes better days will come with the new year.

The upturn could show up as early as the first quarter of 1986, they say, meaning that Europe's recovery could for once be in step with the U. S. market, instead of lagging by six months as it has in the past. The turnaround should bring firmer prices, and there could even be product shortages in some areas until idle capacity has been brought back on stream. Growth next year is still hard to pin down, but could be as strong as 17%, according to Adrian Tarr, an associate director of Dataquest Inc.'s European Semiconductor Industry Service in London.

Many European electronics executives who were packing suitcases last week in preparation for the Salon des Composants—one of Europe's largest components exhibitions—were hardly bursting with joy about the situation; nonetheless, they spoke of the market's near-term future with surprising optimism.

They were heading for the Parc des Expositions Paris Nord to cast an eye over a collection of some 1,270 exhibitions of electronics components and equipment from manufacturers in 30 different countries. Composants alternates years with the large electronics show in Munich.

The reason for the executives' generally positive view of the industry's prospects was essentially historical. The executives reason that the cyclical nature of their business means that prolonged periods of weakness will inevitably be followed by significant, and often dramatic, upturns, as happened in 1983 and several times before that.

AN EARLY UPTURN. Though some marketing mavens expect this move to come as early as the first quarter of 1986, others are more prudent, looking for a turning point sometime later in the year. Nearly everyone agrees, however, that 1986 will be a pivotal year in which the market moves out of the doldrums and paves the way for a strong performance in 1987.

The drop in chip sales this year for Western Europe is around 6%, figures Manfred Schmidt, chief executive of Valvo, the Philips components-producing subsidiary in Hamburg, mainly because of Great Britain's strong decline. Most observers see Great Britain as Europe's weakest major market at the moment. This is because the nation's personal computer industry, traditionally the driving force in British components, is going through an exceptionally difficult period.

The most stable European nation is West Germany, which benefited less from the boom of 1983 but had the least drastic downswing. In France, moderately successful military electronics and data-processing markets are partially offsetting nightmarishly poor telecommunications and consumer sectors.

Taking a too-apocalyptic view of the European components market's prospects is simply a result of not putting the current situation into its proper context, reckons Philippe Dauvin, the chief economist at Thomson-CSF, the principal French components manufacturer. "There are still some pessimists around, but there are nonetheless strong historical reasons why the market should be turning up again soon," he says. "To say that it will not happen is something like affirming that IBM will not continue to make computers or that none of the other factors which have traditionally driven the components market will continue to function.”

At France’s Bureau d’Informations et de Prévisions Economiques, a national economic research organization, components analyst Pierre Romanet agrees with Dauvin’s assessment. “Right now, stocks are high and orders are way down—1985 is not good. But little by little that is changing, and 1986 should be not too bad. And it should set the stage for a very firm 1987.” The BIPE is looking for the French semiconductor market to expand by more than 20% that year.

Compared with the rest of Europe and the U. S., the West German semiconductor market held up fairly well in 1985. To be sure, there were problems of overcapacity and drastic price declines—especially for standard parts such as memories and microprocessors. Overall, however, the slump was not too steep, with the book-to-bill ratio dropping to 0.6 only for a brief period during 1985—for the rest of the year it was higher, but almost always less than one. But then again, West Germany did not enjoy as big a boom in 1984 as did, say, the U. S. and Great Britain.

West Germany’s overall components market will score a 10% gain in 1985 over last year’s volume, according to Valvo’s Schmidt. In the semiconductor sector, overall sales in the country were higher during the first nine months of this year than during the same period last year, reports Gernot Oswald, executive director for semiconductor sales at Siemens AG, in Munich. Right now, the book-to-bill ratio is around 0.8, indicating a drop from the nine-month average of the year to date.

West German chip market fares better than others

Schmidt says West German microelectronics has kept pace with the overall components market, growing by 10% this year. With that gain, he says, “West Germany was among the few countries where microelectronic sales went up this year.”

SAVING GRACE. The prime reason for West Germany’s relatively good performance, Oswald says, was the lack of a strong personal computer industry—a sector that in the U. S. and Great Britain had accounted last year for a hefty share of chip consumption. So the near-collapse of the personal computer market hit semiconductor makers in those countries hard, an experience that West German producers were spared.

Against this background, West German semiconductor makers, as well as foreign companies active on the West German market such as Texas Instruments, Motorola, and Advanced Micro Devices, are not overly pessimistic about 1986. Just when a decided upswing will come is hard to predict, Oswald of Siemens says, “as the market is often subject to mechanisms that are difficult to fathom and predict.” In the past, he says, when stocks were filled in anticipation of strong sales, customers were not buying. On the other hand, demand was often high when stocks were depleted.

But as do most other semiconductor executives, Oswald is hoping for the market to pick up next spring, with the lift fueled primarily by industrial electronics, data processing, and communications. Valvo’s Schmidt expects a gain of at least another 10% in microelectronics next year.

END IS SEEN. Dataquest’s Tarr is less pessimistic than Valvo’s Schmidt and expects the European semiconductor market to decline only 2.2% from 1984’s figure of $4.8 billion—nonetheless a disaster for an industry used to growth rates of 20% and more. Tarr believes the recession has bottomed out, however, citing distributors’ reports that some big companies have started buying again.

The picture varies across Europe, says Tarr. “In the UK the home computer market has disappeared, while in West Germany the automotive sector has held up demand.” In terms of product sectors, dynamic random-access memories have suffered most, with prices down from $3.2 for a 64-K circuit in 1984 to as little as 50¢. Texas Instruments Inc. recently pegged its prices at a nonnegotiable 90¢.

Another market in free-fall, though not nearly so well publicized as the one in RAMs, is the gate-array sector, which is now being given priority by Japanese manufacturers. Some prices, says Dataquest’s Tarr, have fallen as much as tenfold. “In the last six months we have seen prices of 3-μm two-layer metal plastic-packaged 2,000 gate-or-less arrays drop from a price of 2¢ to 5¢ per gate down to 0.2¢ to 0.5¢ per gate. The Japanese have decided that this market is one they want to be in and have entered with very aggressive prices.”

In 1985, there has been a general collapse in equipment demand across every sector of the industry, believes Bryan Down, sales and marketing director for Ferranti Electronics Ltd., a subsidiary of Ferranti plc. So far, the company has managed to avoid layoffs. But they cannot be ruled out if demand does not pick up by the second quarter of 1986, he admits. In Italy, SGS Microelettronica SpA has been unable to escape reducing its manpower and has cut work at its principal Agrate facility to a four-day week. ☐

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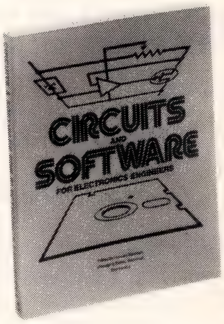

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COMPANIES

COMPUTER AUTOMATION TRIES FOR NEW LIFE

FORMER HIGHFLIER IN MINICOMPUTERS RESTRUCTURES AS TEST-EQUIPMENT MAKER

IRVINE, CALIF.

When the radical surgery under way at Computer Automation Inc. is completed later this year, what will remain of the once high-flying minicomputer company will be a testing division started virtually as an afterthought 10 years ago. The restructuring, done at the behest of directors who took over the reins earlier this year from chief executive David H. Methvin, consists of cutting out the company's now-unprofitable computer business.

The pared-down Computer Automation will stand as an automated-test-equipment company, essentially a corporate version of its profitable Industrial Products Division. To give the newly shaped company even more of an ATE flavor, the president will be Douglas L. Cutsforth, who has run the division since 1979. The only remaining computer business will be a small operation that will sell boards to original-equipment-manufacturer customers of long standing, but on a sharply diminished basis.

Today's Computer Automation is a radical departure from its promising start in the fledgling minicomputer business during the mid-1970s. Then, its bare-bones Naked Mini boards captured much attention when they were introduced, leading many experts to consider Computer Automation's prospects good.

The principal executive at Computer Automation was Methvin, who started the company in 1967, took it public in 1971, and resigned this past March. Noted for a strong-willed management style, Methvin basked in acclaim during the good times but avoided taking tough corrective measures when troubles began to appear.

"If you know Dave, he tends to be the perpetual optimist," says George Pratt, a friend and director for 14 years who became chairman and chief executive when Methvin stepped down. By most accounts, Pratt spearheaded the board's actions late last year that led to Methvin's departure. Sources say Methvin, who left amicably, agreed that he wasn't the best choice to manage the changes. "That would have been most distasteful to him," says Pratt. Methvin declined to be interviewed.

BIG TRIM. First to go was the end-user Commercial Systems Division, sold to W. Norris Agee. The Santa Ana, Calif., businessman paid its book value—$4.72 million—in notes. Computer Automation also consolidated its Richardson, Texas, and Irvine operations to make the computer boards for test equipment and for OEM computer customers.

The restructuring resulted in a net loss of $12.7 million for fiscal 1985, which ended June 30, on sales of about $40.5 million, the company estimates. Pratt expects smaller losses for the first quarters of fiscal 1986.

"Clearly, the decision had to be to concentrate on our strongest asset, ATE," says Cutsforth. When he took over the testing division, it had sales of $8 million. Sales grew to $26 million in fiscal 1985. More important, profits also increased steadily.

Computer Automation's testing activities have advantages that should be enhanced by a higher profile as a separate company, Cutsforth says. Its Marathon functional testers have built a loyal following among major customers. Moreover, more than half are in defense electronics, where demand is steady.

Though most of the pieces for the new company are in place, results of the changes will not become fully apparent until early next year, Cutsforth says. Furthermore, test systems are expensive and sales are adversely affected by the depressed capital-equipment cycle. Still, Cutsforth expects results to improve "because we are now concentrating on parts that are profitable."

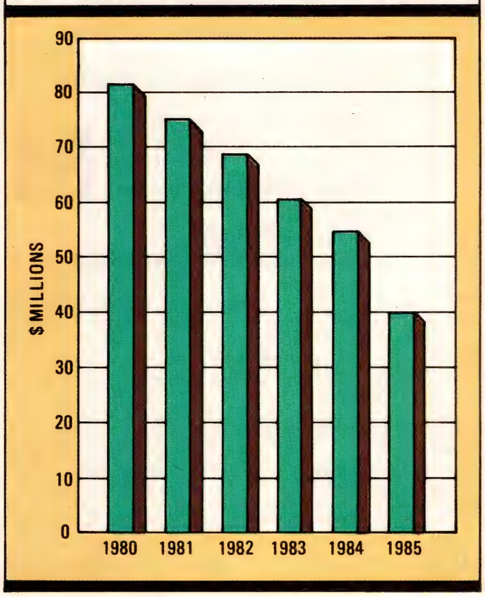
COLLECTIVE DECISION. The decision to restructure the company was made collectively by the board, Pratt says. "We just couldn't sustain those losses . . . and we had a problem Dave refused to recognize." Running into such snags is a common occurrence among small technology companies. After finding initial success with an innovative product—in Computer Automation's case, low-priced stripped-down but advanced computer boards—a company expands too quickly into related businesses that demand more management and capital than are readily available.

From its OEM boards, Computer Automation expanded into end-user minicomputers with its SyFa line in 1975, and this required expensive software, marketing, and service. At about the same time, it started a functional-testing division based on techniques it used for its own boards.

"Computer Automation was spread way too thin," says LeEllen Spellman, vice president at Martin P. Simpson & Co., a New York brokerage company. "They tried to do everything and didn't have the resources."

The company was also hampered by management shortcomings. "That was the No. 1 weakness—Dave didn't trust anybody for very long," says George Dashiell, who headed various computer operations during his 1976-81 tenure and is now in charge of Wespercorp, a Tustin, Calif., maker of disk and tape controllers. "One man can manage a $40 million company. Above that, it needs systems and procedures and the continuity of a management team." *–Larry Waller*

COMPUTER AUTOMATION: FALLING SALES . . .



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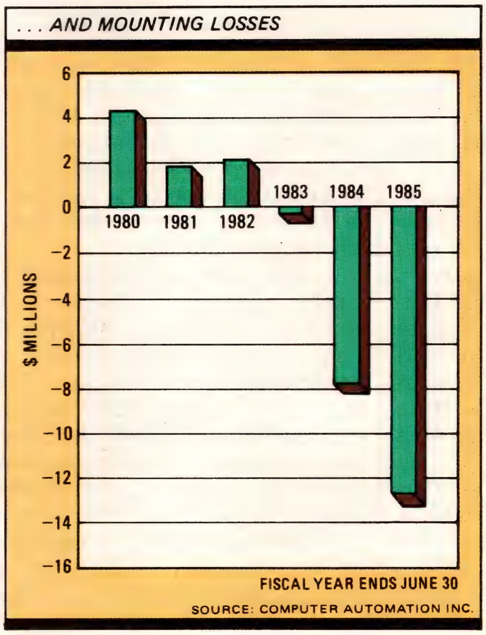

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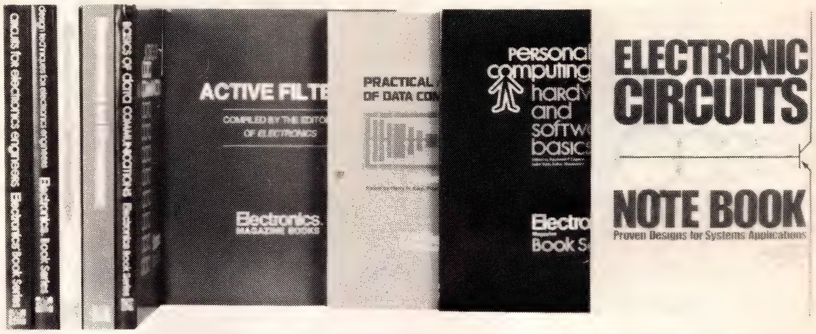
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BOTTOM LINES

PRICE ISN'T KEY IN PERSONAL COMPUTERS

Data-processing executives at major U. S. companies don't pay much attention to price when they consider buying personal computers for their organizations. More important are compatibility with other in-house data-processing equipment and how long they believe that computer suppliers will be building the product. These findings come from a survey by Newton-Evans Research Co., Ellicott City, Md. Compatibility and supplier viability each received a 32% response, according to the survey, followed by connectability, 18%, and applications software, 11%. Price mattered to only 2% of the respondents. A specific operating system or language was important to only 2%. Service apparently was unimportant to those surveyed, because it wasn't named as a factor.

W. R. GRACE UNIT INVESTS IN OMNI

Omni Technology Inc., has received a $500,000 cash infusion from Grace Ventures Corp., a subsidiary of W. R. Grace & Co., New York. In return, Grace Ventures will occupy two seats on the board of the Fremont, Calif., company. Omni, with revenue in fiscal 1985 of $5 million, tests electronic components for the military and aerospace markets. Its services also include the environmental conditioning of equipment, software generation, and inventory-control programs.

UCCEL ACQUIRES SOFTWARE COMPANY

Uccel Corp., a Dallas systems- and application-software company, has acquired Software Corp. of America, Herndon, Va., for $9.9 million in cash. SCA's products, which run under Digital Equipment Corp.'s MVS operating system, include a data-set performance measurement and analysis system, procedure-library system, and a product to aid disaster recovery of computers. Its revenue this year should hit $6 million.

TITAN TO ACQUIRE SPECTRON LABS

Titan Corp., Encino, Calif., has agreed in principle to acquire Spectron Development Laboratories Inc., Costa Mesa, Calif. Terms were not disclosed. Titan supplies design, development, and testing services for defense programs for U. S. government agencies and prime contractors. Spectron applies laser technology to experimental aerodynamics and fluid mechanics.

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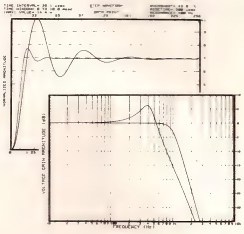

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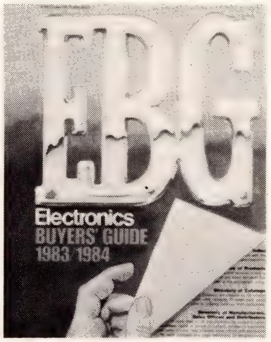

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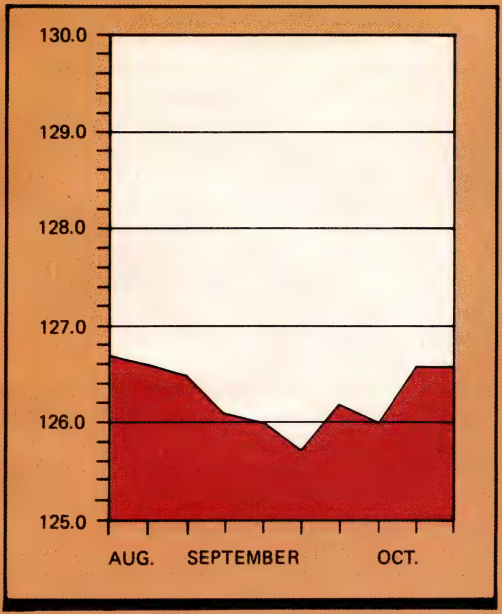
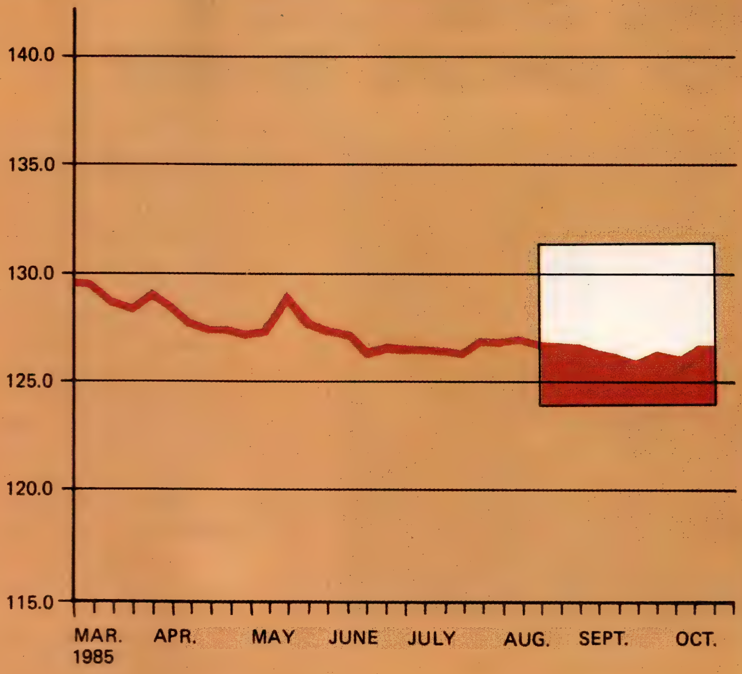
ELECTRONICS INDEX





THIS WEEK = 126.6
LAST WEEK = 126.6
YEAR AGO = 131.5
1982 = 100.0

The *Electronics* Index, a seasonally adjusted measure of the U.S. electronics industry's health, is a weighted average of various indicators. Different indicators will appear from week to week.

U. S. ELECTRONICS IMPORTS & EXPORTS ($ MILLIONS)

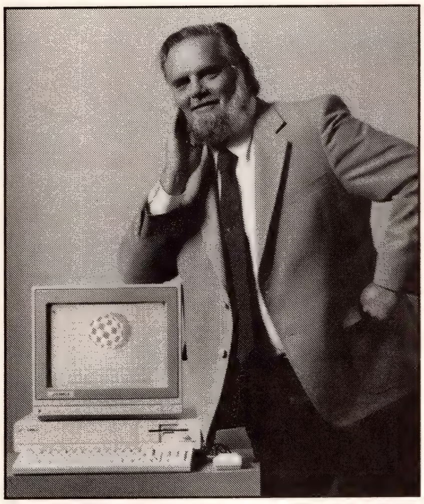
	IMPORTS			EXPORTS		
	August 1985	**July 1985**	**August 1984**	**August 1985**	**July 1985**	**August 1984**
Accounting, computing, and data-processing machines	268.382	337.949	282.514	533.565	512.356	537.912
Calculators	40.556	39.910	46.623	4.984	7.147	7.362
Parts for data-processing machines and office calculators	348.916	310.903	354.641	531.275	401.183	551.526
Telecommunications, sound-recording, and sound-reproducing equipment	1,516.636	1,371.490	1,470.932	297.060	348.484	285.540
Electronic or electric instruments	141.302	143.104	110.323	502.773	521.459	505.114
Printed-circuit boards	24.511	22.696	25.234	22.109	22.651	28.438
Integrated circuits, diodes and other semiconductors, tubes, piezoelectric crystals, parts	446.224	426.861	744.669	344.715	346.901	493.940
Fixed and variable resistors	16.000	18.331	25.714	11.034	11.549	16.341

Mixed results in the trade picture for electronic equipment added up to no movement in the *Electronics* Index for the current week. Imports rose 5% in August, according to the latest statistics, ending hopes that July's 8% decline would start a sustainable trend. The optimism brought about by last week's news of a rise in U. S. production of electronic equipment was tempered by a downward revision in the final statistics, which will show up in the index in coming weeks. Exports of electronic equipment, up 3.4% in August, couldn't offset the gain in imports and prevent a widening in the U. S. electronics industry's trade deficit. Hence, the excess of electronics imports over exports rose 11% in August to $555 million.

Though total electronic-equipment exports were up, this was caused by a 32% rise in shipments for parts for computers and data-processing equipment and a small gain in exports of computers and office machinery. All other segments saw exports fall. The U. S. dollar appears to have lost its downward momentum. With no impetus in sight for any further significant decline in the value of the dollar, it is uncertain when U. S. electronics manufacturers will be able to reclaim their former share of overseas markets.

PEOPLE

WILL 13 BE LUCKY FOR AMIGA'S MINER?



CATALYST. Miner led the development team for the Amiga personal computer.

LOS GATOS, CALIF.

Just one year ago, Amiga Corp. was acquired by Commodore International Ltd. Once the ink was dry on the documents, Jay Miner began working for the 13th company since his chip-design career began 22 years ago.

"I get bored easily," says Miner, who led the development team for the Amiga personal computer. He is now vice president of product development for Commodore-Amiga Inc., the division that brought the Amiga to market after a lengthy and expensive gestation. "After a while [working for the same company], you get bogged down in details and you don't learn anything new."

In all this moving around, Miner, 53, never ventured far from Silicon Valley. He earned his BSEE from the University of California at Berkeley in 1958. However, the MOS-design specialist has run the job gamut from tiny startups "not worth naming" to General Microelectronics (the first spinoff of Fairchild Camera & Instrument's legendary Semiconductor Division), Siliconix, and Zymos. He even spent four years at Atari Inc., whose chairman, Jack Tramiel, formerly ran Commodore and now considers it his arch-rival.

SURVIVAL AT STAKE. The Amiga is critical to Commodore's future in home computers. Its main claim to fame is powerful color graphics provided by a Motorola 68000-based architecture and three custom very large-scale-integration chips—for graphics, stereo sound, and animation. The company hopes such innovation will help it grab a share in the personal computer marketplace. And some analysts believe the Amiga is Commodore's last hope to regain a leading position in the home computer field.

After Miner's stint at Atari, he spent two years in custom VLSI chip design at Zymos. Then in 1982, at the behest of Zymos president Bert Braddock, a friend of Amiga's initial investors, he donned employee badge No. 2 at Amiga.

"When I came on, it was a one-man company, but with offices and money," says Miner. "[Founder Dave Morse] asked if I would help him spark things from an engineering point of view."

A spark was sorely needed. "The investors were just in time for the bubble to burst in the video-game market," says Miner, who says the Amiga started as a cartridge-based game machine. "And ever since I was at Atari, I've wanted to use a 68000 chip in a fancy home computer."

Three years later, guiding a four-person development team, Miner brought his embellished idea to fruition. With such a major and successful project under his belt, might a man with no tolerance for boredom think of moving on? It seems that Commodore already thought of that. "Nope, I'll be here another four years," says Miner with a grin. "I've got a contract." *–Denise Caruso*

EDWIN PUSHES GaAs MINISUPER

CAMARILLO, CALIF.

When Allan I. Edwin first heard of Vitesse Electronics Corp.'s planned minisupercomputer earlier this year, he was being wooed as a potential customer. But the machine—designed initially with high-performance CMOS devices,

PEOPLE ON THE MOVE

IVAN A. CERMAK

☐ Telecommunications expert Ivan A. Cermak, 44, joined California Microwave Inc., Sunnyvale, Calif., as executive vice president of telecommunications. He was formerly president of System 12 and Network Systems Division for ITT Corp. and spent 12 years at AT&T Bell Laboratories. Cermak has operating responsibility for the firm's digital and microwave transmission products and for venture operations.

JOHN T. HARTLEY

☐ John T. Hartley is capping a 30-year career at Harris Corp. with the job of president and chief operating officer. He succeeds Joseph A. Boyd, who remains chairman of the board. Hartley, 55, was on the faculty of his alma mater, Auburn University, before joining the Melbourne, Fla., company as a research engineer in 1956. He was elected president of Harris in 1978 after serving as executive vice president for two years.

DAVID J. MARKEY

☐ Following the lead of many who left government jobs for the private sector, David J. Markey, assistant secretary of commerce and administrator of the National Telecommunications and Information Administration, will leave the Commerce Department to become vice president of federal regulatory affairs for BellSouth Corp. Markey, 45, will direct the Atlanta-based regional telephone company's liaison programs with the FCC and related agencies. Before joining the Commerce Department, he was a special adviser to the FCC chairman and served as chief of staff and legislative director for senators Frank Murkowski (R., Alaska), and J. Glenn Beall (R., Md.). As NTIA head, Markey served as chief presidential policy adviser on telecommunications.

DAVE MASTERS

☐ Dave Masters has joined Opus Systems as vice president of engineering and operations. His engineering and management positions, spanning a 25-year career in electronics, include stints at such companies as Synertek, Fairchild Camera & Instrument, and National Semiconductor Corp.'s Point-of-Sale Division. Masters was formerly vice president of systems development at Onyx Systems Inc. Opus sells a Unix coprocessor for the IBM Corp. Personal Computer, based on National's 32000 chip set.

ROBERT J. BROWN

☐ Diablo Research Corp., Sunnyvale, Calif., hopes to strengthen its consumer and commercial lines by adding Robert J. Brown as vice president of engineering. He worked previously on the development of an entertainment system for commercial airliners at Interactive Communications Corp., a San Jose, Calif., subsidiary of Altus Corp. He also worked as vice president of engineering at Hitachi Microelectronics Systems Inc. Brown helped put Atari Corp. on the home-video-game map by forming the Consumer Division to market a home version of Nolan Bushnell's Pong game.

largely to be replaced later with gallium arsenide chips—so intrigued him that the veteran engineering executive jumped over to the company, where he is now responsible for making the machine a reality.

BELIEVER. Edwin has faith in GaAs.

Sources in the semiconductor and computer business think his task is "tough, if not impossible," in Edwin's words. But he thinks this pessimism works as an advantage, driving off would-be competitors. "We hope a lot of people feel that way—to keep the GaAs mystique to ourselves as long as we can."

Vitesse, a $30 million GaAs startup financed by parent Norton Co., hopes to have its first GaAs large-scale-integration parts available for sampling next year. In a more ambitious move, the company's first production minisupercomputer in silicon is due for 1987, with GaAs components to be integrated as they become ready.

Edwin, 42, describes his job as "motivating and forcing the interactions" of his 30-person division. His career has prepared him for this—he has done most of the jobs himself at one time or another. He holds a BS from New York University and an MS from the University of Michigan, both in electrical engineering, and most recently served as general manager of a new business unit of General Electric Co.'s Medical Systems Group. Edwin also founded and headed Interactive Systems, Ann Arbor, Mich., which went on to become a pioneer company in local-area networking.

TOUGH JOB AHEAD. The soft-spoken Edwin by no means downplays the difficulty of his assignment as president of Vitesse's Digital Products Division, which generally involves overseeing the translation of the design to hardware. He points out, however, that the trick is a well-thought-out basic computer architecture that in silicon not only performs mightily—tens to hundreds of megaflops (millions of floating-point operations per second)—but can also be upgraded in increments with GaAs parts without disrupting the design.

At this stage, Edwin is still keeping details close to his vest, but he defines the approach as "decoupled architecture, or what some might call asynchronous modules." This means individual modules at the board level may be replaced without affecting other computer elements. Such elements for upgrading are chosen to exploit the speed of GaAs, which can be up to seven times that of silicon parts. *–Larry Waller*

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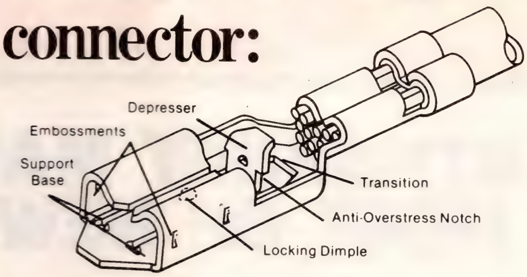

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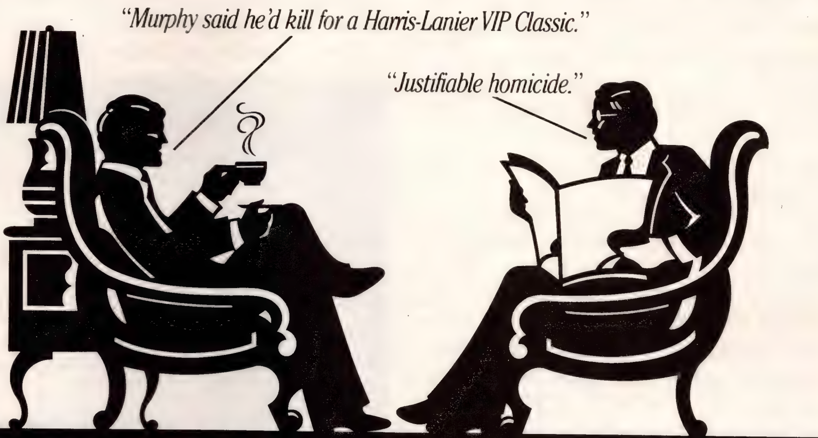
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NEW PRODUCTS

ETHERNET MANAGER HAS HOST OF NEW FEATURES

BRIDGE ADDS AUDIT TRAIL AND AUTOMATIC DATA REDUCTION

Features never before available on a local-area-network management and control system will be standard on Bridge Communications Inc.'s multifaceted NCS/1 network control server, the company claims. Besides giving administrators of Ethernet LANs the ability to centrally configure, control, and monitor large networks in real time, it includes the first network audit trail as well as automatic data reduction, whereby raw network data is simplified and organized into useful form.

NCS/1 consists of Bridge's network software running with the AT&T Bell Laboratories Unix operating system on a Sun Microsystems Inc. 2/120 work station. It can reduce and manipulate up to 3 megabytes of data, render it in graphical form, and store it on the system's 71-megabyte Winchester disk.

"Network management is a new concept," says William Carrico, Bridge's president. "Before, just getting onto a network was a big thing. As sizes increase, however, there is a need to monitor and control the network. Thus we saw a demand for increased functions in those areas."

NCS/1 operates in Sun's desktop environment with multitasking windowing capability and supports up to 256 of Bridge's communications and gateway servers on a net. It can support up to 4,096 logical names assigned to physical addresses within the network, but Carrico says this number does not limit the number of network users to 4,096.

BIG NUMBERS. "For example, some people with a VAX computer on a network can simply call all the VAX ports 'VAX,' which uses only one name," Carrico explains. "We figure that between 10,000 and 20,000 users could actually be supported with the product."

Supporting such a number of users is only one of the many tasks NCS/1 offers network administrators. The product's audit-trail feature is an industry first, according to Carrico. "No one else has an audit-trail connection on a LAN," he claims. "That technology was originally developed for modem networks. As such, it's of big interest to our traditional transaction-oriented customers."

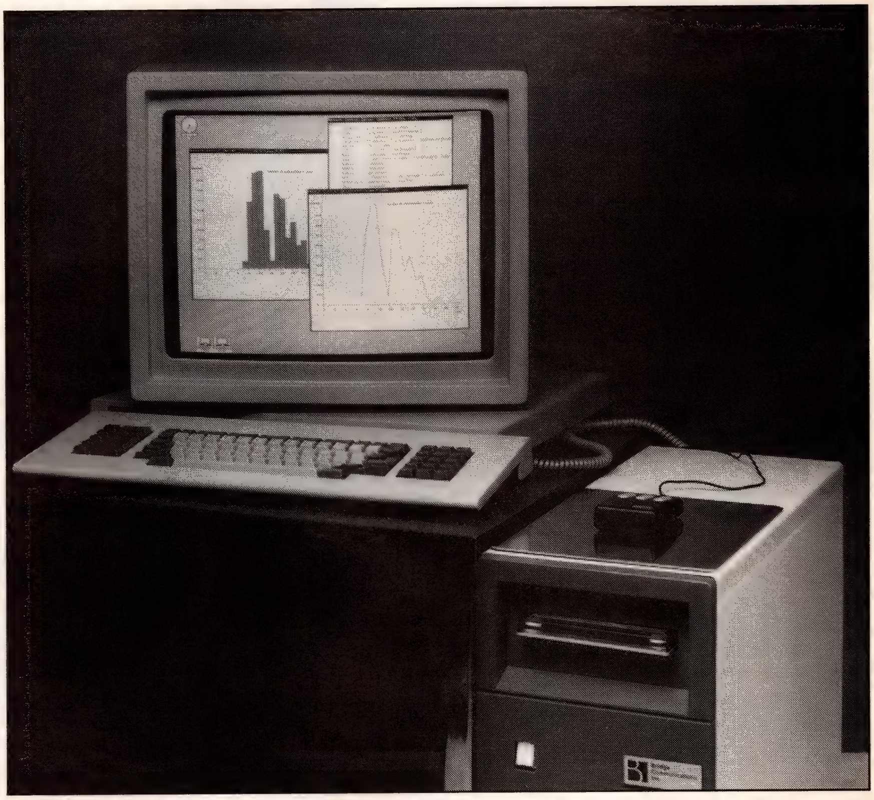
The audit-trail analysis time-stamps and records information on all network connections and functions, shows connection source and address, status, duration, and amount of traffic in terms of number of packets or bytes. The audit trail can be spooled out to ¼-in. cartridge tape or sent to a printer.

The system can also sense total network load as well as bandwidth use. Its Intelligent Ethernet Controller, a card that can be inserted in the NCS/1, uses a 10-MHz Motorola 68000 microprocessor with 256-K bytes of memory and performs all protocol processing. This leaves the work station's main processor free to perform other critical network-management tasks.

This feature is necessary because Unix is not a real-time operating system and 256 servers could make the system less responsive to the network administrator, says Carrico. Thus the Ethernet controller handles all network communications and receives data off the network in real time, serving as a buffer until the work station's processor can handle it.

TEN TIMES FASTER. As a result, the NCS/1 system can send or receive 200 packets of information per second. In addition, it boots each network server in 4 s—10 times faster than Bridge's previous network manager, the NCS/150. The 150, an entry-level network-management system, was limited to simple data collection. Information could not be reduced automatically to graphical representations, as it is with the NCS/1. "You could only send it to the printer or reduce the data yourself," says Carrico. Also, it could monitor a maximum of only 40 physical addresses.

Programmable keys are also available at each work station under NCS/1, and network administrators have the same capability through command scripts at the NCS/1 station. Command scripts let



VALUE ADDED. Bridge's Ethernet manager is built around Sun work stations.

administrators build a command file that automates sequences of daily management tasks such as checking host ports for baud rates or monitoring certain kinds of usage. In addition, the manager can examine remote units and perform administrative tasks on remote servers.

Aimed at customers having more than 100 network nodes, or users, NCS/1 sells for $45,000. Carrico says a token-ring version of the system will be available in 1986. *–Denise Caruso*

Bridge Communications Inc., 1345 Shorebird Way, Mountain View, Calif. 94043. Phone (415) 969-4400 [Circle reader service number 338]

SURFACE-MOUNTED CERDIP HOUSES PLA

Altera Corp. believes the total appeal of its new 900-gate ultraviolet-erasable programmable logic device (EPLD) will be greater than the sum of its parts. The Santa Clara, Calif., company claims the EP900 combines the best features of the three other members of its family, providing the greatest flexibility and highest integration possible for a programmable logic device.

Altera pioneered EPLD technology with its EP300, introduced in June 1984, and continued to add features such as more I/O lines, clocks, registers, register controls, and programmable architecture to its later versions—the EP600 and EP1200.

The EP900 includes all these features but has one characteristic all its own: it will be offered in a surface-mountable 44-lead J-leaded chip carrier that uses Cerdip technology, as well as in the standard 40-pin DIP. The chip carrier takes up less than 1 in.^{2} of board space and is half the height of the DIP version.

"This is the first time Cerdip technology has been applied to surface-mount technology commercially, in a windowed version," claims Robert F. Hartmann, vice president of engineering for Altera. "We're providing both package types because, although we believe surface-mount technology will be used in more than 25% of all ICs by 1990, most handling equipment is geared to DIP, and there will be a transition time before the technology is widely accepted."

Hartmann says Altera chose the Cerdip implementation because it is a proven and inexpensive method for making hermetic packages, using a ceramic base and lid with glass in between. But the company also will provide a nonwin-

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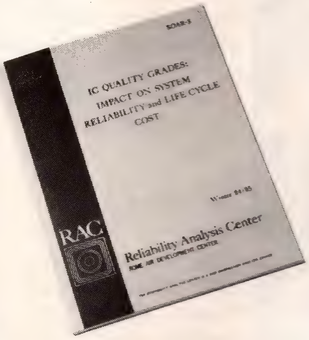
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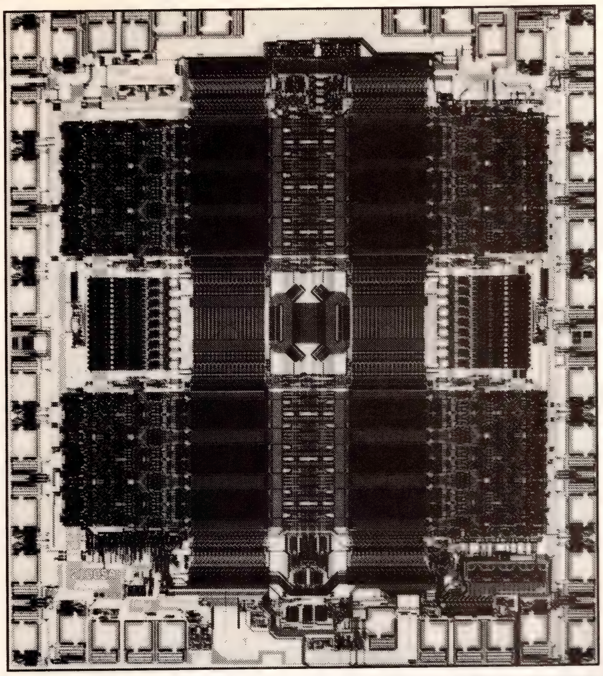


NEW HOME. Altera's erasable programmable logic array comes in a surface-mountable package that uses Cerdip technology.

dowed plastic package for a one-time programmable version of the EP900 during the first half of 1986.

The company has not yet set prices for the different versions of the EP900. Evaluation units will be available in December, with support, for $44 each.

The EP900 can be completely tested before it is programmed and has transition-detection input circuits for zero-standby power, a feature Altera claims it alone has accomplished in the programmable-logic-device market. Other features include 24 I/O lines and 12 inputs; more than 1,000 gate equivalents; 24 programmable flip-flops; and synchronous/asynchronous flip-flop clocking.

Based on Intel Corp.'s 2-μm CHMOS II process, the EP900 array is expected to be used for high-complexity random logic, complex-state machines, large counters, flexible bus interfaces, and random logic using mixed flip-flop types. In addition, the part is suitable for specialized controllers intended for video synchronization, universal asynchronous receiver/transmitters, multiplexers, telecommunication equipment, and instrumentation. *–Denise Caruso*

Altera Corp., 3525 Monroe St., Santa Clara, Calif. 95051.
Phone (408) 984-2800 [Circle 339]

SRAM LOGIC ARRAY: ASICs WITHOUT THE DRAWBACKS

Add a new weapon to the reprogrammable-logic-cell-array arsenal: static RAM technology. Startup Xilinx has combined a gate-array-like architecture with CMOS static-RAM technology to produce a chip with many of the advantages of semicustom application-specific ICs but none of the drawbacks.

"Logic cell arrays provide all the benefits associated with other ASICs—reduced chip count, high performance, smaller system size, lower power consumption, and high reliability—with none of the time, cost, and risk penalties," says Scott Brown, vice president of the San Jose, Calif., company.

The XC 2064 logic cell array has the equivalent of 1,000 to 1,500 gates, putting it midway between smaller gate arrays and programmable logic arrays in complexity. Like PLAs, the logic cell array can be programmed and tested in-house in about one week, using Xilinx's $20,000 development system. Gate arrays take longer and are more expensive to use, with engineering charges incurred for each gate-array design.

The reprogrammable logic cell array's architecture has a central array of logic blocks surrounded by I/O blocks. Users can configure the logic and I/O blocks and connect them in a variety of ways. User-configuration data is held in SRAM within the chip; in a system, the data is read into the RAM from EPROMs, EEPROMs, or a floppy-disk drive.

It is the SRAM technology that makes the logic cell arrays reprogrammable. Reprogramming takes just 12 ms and can be done without removing the logic array from the system.

REPLACEMENT. The XC 2064, which contains 64 logic blocks and 58 I/O blocks, can replace small gate arrays, from 15 to 75 small- and medium-scale ICs, or blocks of four or more PLAs.

The chip, which is manufactured using a high-performance CMOS process, will be offered initially with an 18-MHz clock frequency; a 33-MHz version is on the way. Xilinx's development system provides a number of functions, including design entry (in either graphical or text input form), design-rule checking, PROM formatting, simulation and verification, macro library, and in-circuit emulation. The Xact development software runs on an IBM Corp. Personal Computer. The XC 2064 logic cell array is available now for $55 to $80 each, depending on packaging and the number of parts ordered. *–Steve Zollo*

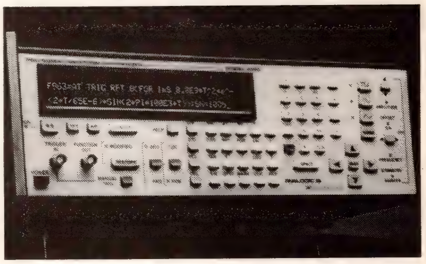
Xilinx Inc., 2069 E. Hamilton Ave., San Jose, Calif. 95125.
Phone (408) 559-7778 [Circle 340]

WAVE GENERATOR USES MATH INPUT

A waveform generator promises greater flexibility and ease of use by allowing engineers to create complex waveforms by simply entering mathematical equations that describe them. The Data 2020 Polynomial Waveform Synthesizer from Analogic's Data Precision Division synthesizes waveforms digitally using a 16-bit 68000-based CPU with 24-bit floating-point capability. A separate 8-bit 8031 microprocessor handles display and keyboard functions.

With existing arbitrary waveform generators, users must enter data point by point or in straight line segments. This approach not only requires a great deal of labor but also confronts memory limitations. The only alternative has been to build discrete circuits for generating specific waveforms. But the Data 2020 generates waveforms by direct front-panel or IEEE-488-bus entry of the polynomial equation describing the waveform. Besides saving labor, the instrument is said to enhance horizontal and vertical linearity.

Standard memory is 64-K by 16 bits, and Analogic offers 128-K words as an option. The efficient use of memory is enhanced by dynamic looping, a software feature that repeats waveform portions with nonrepetitive sections without duplicating the data in memory.



SIMPLE MATH. Waveforms can be created simply by entering polynomial equations.

A compression feature eliminates superfluous sequential data points, so extended dc output levels occupy just one memory location. Entry capabilities are combined with a math package that includes a wide-range phase-locked-loop frequency synthesizer, intelligent real-time output memory control, and an internal waveform library.

Output frequency is 25 MHz or an optional 100 MHz. Users can select a point duration from 40 ns to 500 s. Like other sophisticated waveform generators, the instrument produces ramp, square, triangle, pulse, and sine waves. It also incorporates a white-noise generator with output that can be summed with various deterministic waveforms to produce calibrated signal-to-noise ratios from 0 to –60 dB.

Output is ±5 V into a 50-Ω load with a total dynamic range of 136 dB, a 10-ns rise time, and a 40-ns settling time. S/N ratio is in excess of 72 dB and frequency response is greater than 30 MHz. The system can be used as a 16-bit digital generator because it also puts out digital data. It comes as either a standard 19-in. benchtop model or in a rack-mountable configuration, called the Data 2000, for computer-controlled remote operations. An IEEE-488-bus interface is standard on the Data 2000 and optional on the 2020. The Data 2020 sells for $7,990 with delivery taking from 60 to 90 days. *–Craig D. Rose*

Analogic Corp., Data Precision Division, 16 Electronics Ave., Danvers, Mass. 01923. Phone (617) 2436-1600 [Circle 342]

SCOPES REPLACE STAND-ALONES

Two digitizing oscilloscopes provide an array of functions to measure and characterize complex modulated analog signals. The pair can be designed into automated-test-equipment systems, taking the place of a number of stand-alone instruments.

In addition to features typically found in digital scopes, the 5180T/U and 5183T/U perform functions usually done by counters, time-interval meters, power meters, distortion analyzers, and waveform analyzers.

The 5183T combines a new waveform analyzer and display with a new 4-megasample/s waveform recorder having 12-bit resolution and 512-K-word memory. The 5180T includes the new analyzer and display but uses one of HP's existing recorders, a 20-megasample/s model having 10-bit resolution and 16-K-word memory. The U versions include another recorder, for a total of four input channels.

The scopes can measure frequency,

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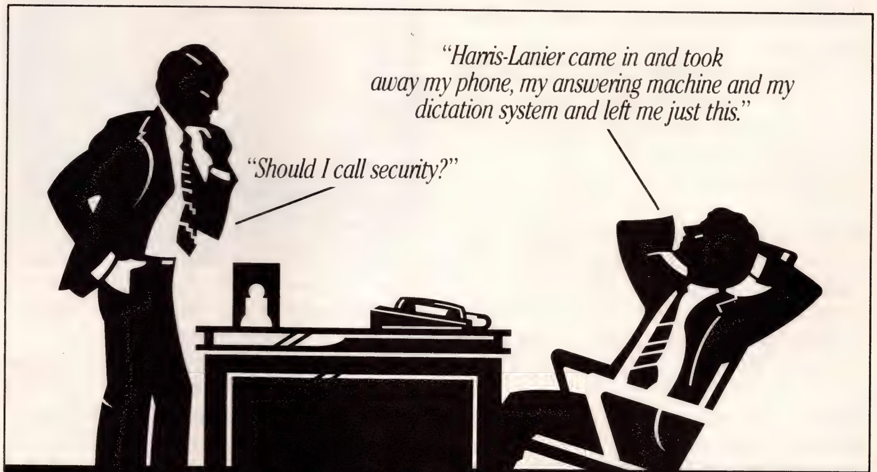
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Circle 69 on reader service card

root-mean-square volts, peak-to-peak volts, pulse parameters, and frequency spectra. The 5183T sells for $19,990, the 5180T for $29,100. Delivery takes 12 weeks.

Hewlett-Packard Co., Inquiries Manager, 1820 Embarcadero Rd., Palo Alto, Calif. 94303 [Circle 380]

SYSTEM BUILDS BRIDGE TO ENTIRE VAX FAMILY

With Version 2.0 of Digital Equipment Corp.'s VAX-11 RSX software, system integrators can develop and run programs for the PDP-11 computer family on the MicroVax II computers. The RSX-11 operating system is used on a large number of installed PDP-11 computer systems.

Version 2.0 builds a bridge for the entire family of DEC computers, from VAX cluster systems to PDP-11 microcomputers and the Professional 300 series of desktop computers. VAX-11 RSX runs under the VMS operating system, enabling any VAX computer to be used to develop programs for PDP-11s and Professional 300 series models.

Programs developed using VAX-11 RSX will run under the following PDP-11 operating systems: Micro/RSX, RSX-11M-Plus, RSX-11M, RSX-11S, and P/OS. License fees for Version 2.0 start at $800 on the VAXstation II and $4,000 on large VAX configurations. DEC will deliver in 30 days.

Digital Equipment Corp., 129 Parker St., Maynard, Mass. 01754.
Phone (617) 493-5489 [Circle 354]

NETWORK SOFTWARE LINKS PC, VAX, WANG

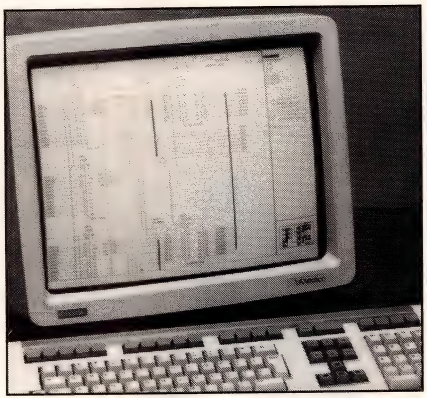
The Strategic Network Environment (SNE) family of networking software products connects various makes of computers in large offices. The first of these products, SNE/FTF (File Transfer Facility), links IBM Corp.'s Personal Computers and IBM/MVS with a DEC VAX or a Wang/VS. It enables users to send and receive files from one system to another without any knowledge of network topology or node properties.

SNE/FTF supports all record formats for transferring sequential, partitioned-data-set, virtual-storage-access-method, and generation-data-group files between MVS hosts and other computers. Network security is incorporated through user profiling. Prices are set on a per-computer basis. The initial license fee is about $17,500 per host, $5,000 per minicomputer, and $400 per personal computer. SNE/FTF is available now.

Software Research Corp., 1 Natick Executive Park, Natick, Mass. 01760.
Phone (617) 655-1133 [Circle 355]

CAE PACKAGE ADDED TO MicroVMS SYSTEM

The CT4000 computer-aided-engineering package is the first to run under Digital Equipment Corp.'s MicroVMS operating system, the developer says. It also turns the IBM Corp. Personal Computer into an intelligent terminal, passing graphical and hierarchical descriptions between the PC and a VAXstation I or II. By using PCs for routine engineering jobs such as schematic design and component creation, then switching to the VAXstation for more computation-intensive functions such as design compilation and simulation, the engineer can optimize the pc-board design process.



The CT4000 package includes a graphics editor, a Scald hardware compiler and netlist postprocessor, pc-board-layout tools, and other modules. The CAE package supports the VAXstation's monochrome display.

The single-user price is $11,900. The CT4000 is available now.

Case Technology Inc., 633 Menlo Ave., Suite 250, Menlo Park, Calif. 94025.
Phone (415) 322-4057 [Circle 357]

CMOS OP AMPS FIT BIPOLAR SOCKETS

A line of CMOS operational amplifiers features a wide operating-supply-voltage range and a guaranteed offset of 5 μV at 25°C, the company claims.

The operating-supply-voltage range for each version is –3 to –16 V, with a supply current of 2 mA maximum for the MAX420 and MAX421, and 0.5 mA maximum for the MAX422 and MAX423. The input specifications eliminate offset-voltage trimming, periodic recalibration, and system errors caused by faulty or misadjusted trimming potentiometers.

Systems can be upgraded by replacing existing bipolar op amps operating off standard analog supplies of ±15 V with one of the MAX400 family models. The CMOS op amps make use of chopper-stabilized techniques.

The chopper-stabilized op amps use a nulling scheme that corrects the dc offset-voltage error and offset drift over time and changes in temperature. An internal nulling amplifier corrects its own voltage-offset error as well as the voltage-offset-error time of the main amplifier.

The MAX420 family is available in three temperature ranges—0°C to 70°C, –40°C to +85°C, and –55°C to +125°C. Prices range from $5 to $15. Delivery is from stock.

Maxim Integrated Products, 510 N. Pastoria Ave., Sunnyvale, Calif. 94086.
Phone (408) 737-7600 [Circle 365]

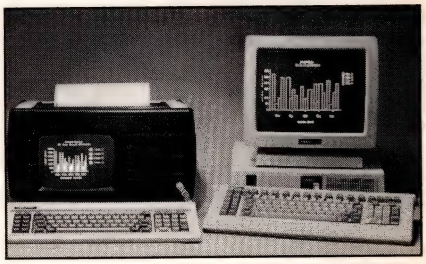
UNITS ENCLOSE PC COMPATIBLES

Three basic enclosures house a wide range of components to create a number of IBM Corp. Personal Computer-compatible systems. The low-profile enclosure, just 3½ in. high, can be used as a diskless computing module or as a data-storage module housing up to two half-height 5¼-in. disk drives. The standard-profile, 6-in.-high enclosure handles an 8088-based system board and up to two floppy-disk drives. It has eight expansion slots.

The transportable enclosure comes with keyboard, 9-in. screen, and power supply. Up to two disk drives can be built in, with optional printer and modem. A typical system weighs 33 lb.

A PC-compatible sells for about $1,895, a PC/XT-compatible for $2,695, and a PC AT-compatible for $3,495. All three are available now.

Oemtek Inc., 3707 Williams Rd., San Jose, Calif. 95117.
Phone (408) 247-1100 [Circle 368]



COMPUTERS

PC-AT COMPATIBLES OUTRUN REAL THING

The AP (for Advanced Processor) line of business personal computers is compatible with IBM's PC AT yet runs 35% faster, Honeywell says. It is available in five models, all expandable to 4 megabytes of memory and up to 80 megabytes of mass storage.

The XP (for Extended Processor) series is 60% faster than the IBM PC/XT, with which its three models are compatible. Main memory for this series can be expanded to 640-K bytes and mass storage to 50 megabytes. Both the AP and the XP can communicate with Honeywell's minicomputers and mainframes over the microSystem VIP terminal-emulation package.

Prices for the AP series start at $3,785, and for the XP series, at $2,495. Licensing fees for microSystem VIP software start at $400. All products are being shipped this month.

Honeywell Telemarketing Center, Honeywell Plaza, MS MN-12-4164, Minneapolis, Minn. 55408 [Circle 369]

MICROVAX II CAN NOW STORE 1 GIGABYTE

The latest model of the MicroVax II work-station line gives users as much as 1 gigabyte of mass storage in a single system cabinet. Up to 33 serial lines can be connected to the system, which incorporates a hard-disk controller that boosts throughput by 20% to 45% over earlier versions.

Applications for the MicroVax II's high-capacity data storage include computer-aided design as well as large scientific and commercial time-sharing enterprises.

Prices for the basic system start at $42,505. The customer must add one of two disk options priced at $17,140 or $18,640. Delivery takes 30 days.

Digital Equipment Corp., 129 Parker St., Maynard, Mass. 01754. Phone (617) 493-5489 [Circle 370]

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ELECTRONICS WEEK

TI TO SHUT PLANTS, LAY OFF 2,200

Texas Instruments Inc. is closing an assembly-and-test facility in El Salvador and a wafer-processing site in Houston after posting $82.8 million in net losses for the quarter that ended Sept. 30. The company is also consolidating operations in its Data Systems Group, reducing the number of computer-equipment plants from four to two. Personal computer assembly will be moved from College Station, Texas, to TI's Austin site. Terminals and peripherals manufacturing is being transferred from Cypress, near Houston, to Temple, Texas; the Cypress plant is up for sale; TI wants to cut costs in its troubled computer operation by about $70 million a year. The Dallas company is also laying off 2,200 workers worldwide, bringing the total furloughed this year to 7,000. Pay raises slated for early 1986 have been deferred.

INDUSTRY SALES SHOW INCREASE

Sales by U.S. electronics companies in June were the highest in any month since last December, according to the American Electronics Association. The total was an estimated $21.5 billion, up 3.4% over June 1984 and just short of December 1984 sales of $22.2 billion. For the first half of this year, more than $113 billion of goods and services were sold, up 4.5% over the same period last year.

EQUIPMENT MAKERS EXPAND OVERSEAS

Manufacturers of semiconductor equipment and materials are planning significant overseas expansion, according to a survey made by the Semiconductor Equipment and Materials Institute. The results reflect the growing dependence of manufacturers on overseas business and the increasing difficulty of selling abroad without a presence in the target country. Of the U.S. companies responding, 38% plan expansions in Japan over the next year and 36% will expand in Europe. Some 68% of the Japanese companies responding said they plan to increase operations in the U.S. and 45% will expand in Europe. Half the European companies will increase U.S. operations and 32% will expand in Japan.

TEST SET ON HOME DATA SERVICE

Pacific Bell, San Francisco, has lined up nine companies—including providers of videotext services, a community bulletin board, home banking, messaging, and remote data-base access—for its Victoria home data service. Victoria, a technology that carries two voice and five data channels over a single two-wire phone line [*Electronics Week,* April 1, 1985, p. 23], will be field-tested with 200 home subscribers in Danville, Calif., beginning in February.

HUGHES SATELLITE STARTS WORKING

An ailing Hughes Communications Co. satellite, Leasat 3, has come to life and is on its way to a permanent position 22,300 miles in space. The craft had been drifting in low orbit since its rockets failed to start after it was launched from the space shuttle in April. On Oct. 27, engineers from Hughes gave commands that activated a small rocket on the satellite, which was due to reach its final position over the past weekend, when its antenna will be deployed and tests begun. Astronauts aboard the space shuttle Discovery saved Leasat 3 in late September by hot-wiring the control panel to receive ground commands. The satellite is one of four Hughes has contracted to operate for the U.S. Navy.

SIEMENS KNOW-HOW HEADS FOR CHINA

In an effort to increase its presence in the People's Republic of China, Siemens AG, Munich, has signed an agreement to supply know-how as well as hardware for goods ranging from automation gear to medical electronic systems, components, and communications equipment.

FORD BUYS INTO AI SOFTWARE FIRMS

Ford Motor Co. is investing $14 million in each of two companies in the artificial-intelligence software business. This will give the auto maker a 10% ownership interest in both Inference Corp., Los Angeles, and the Carnegie Group Inc., Pittsburgh. Inference will adapt its expert-system software for Ford's financial services and vehicle assembly. The Carnegie Group, a developer of natural-language and software-writing tools, is already working on AI diagnostic systems to improve customer service for Ford.

RCA TO LAUNCH POWERFUL TV BIRD

Final testing is under way for Satcom K-2, which will be the nation's most powerful domestic communications satellite. Lift-off aboard the space shuttle Atlantis is scheduled for Nov. 27. With 16 45-W transponders, Satcom K-2 will be the first of three $\mathrm{K^u}$-band satellites to be operated by RCA American Communications Inc. to distribute TV programs and link offices.

GCA WILL SELL INSTRUMENT GROUP

GCA Corp., the Bedford, Mass., builder of wafer steppers and other chip-manufacturing equipment, plans to sell its Chicago instrument and equipment group and expand its rapidly growing factory-automation business, as well as its semiconductor capital-equipment and precision-optics segments. The company lost $38.9 million in the last quarter.

VERBATIM MOVES OPERATIONS

To save on labor costs, Verbatim Corp. will transfer its floppy disk manufacturing from Silicon Valley to North Carolina, Ireland, and Mexico. The company will dismiss some 400 Silicon Valley workers with three months' salary and benefits. Marketing and technology development will stay at Verbatim's Sunnyvale, Calif., headquarters.

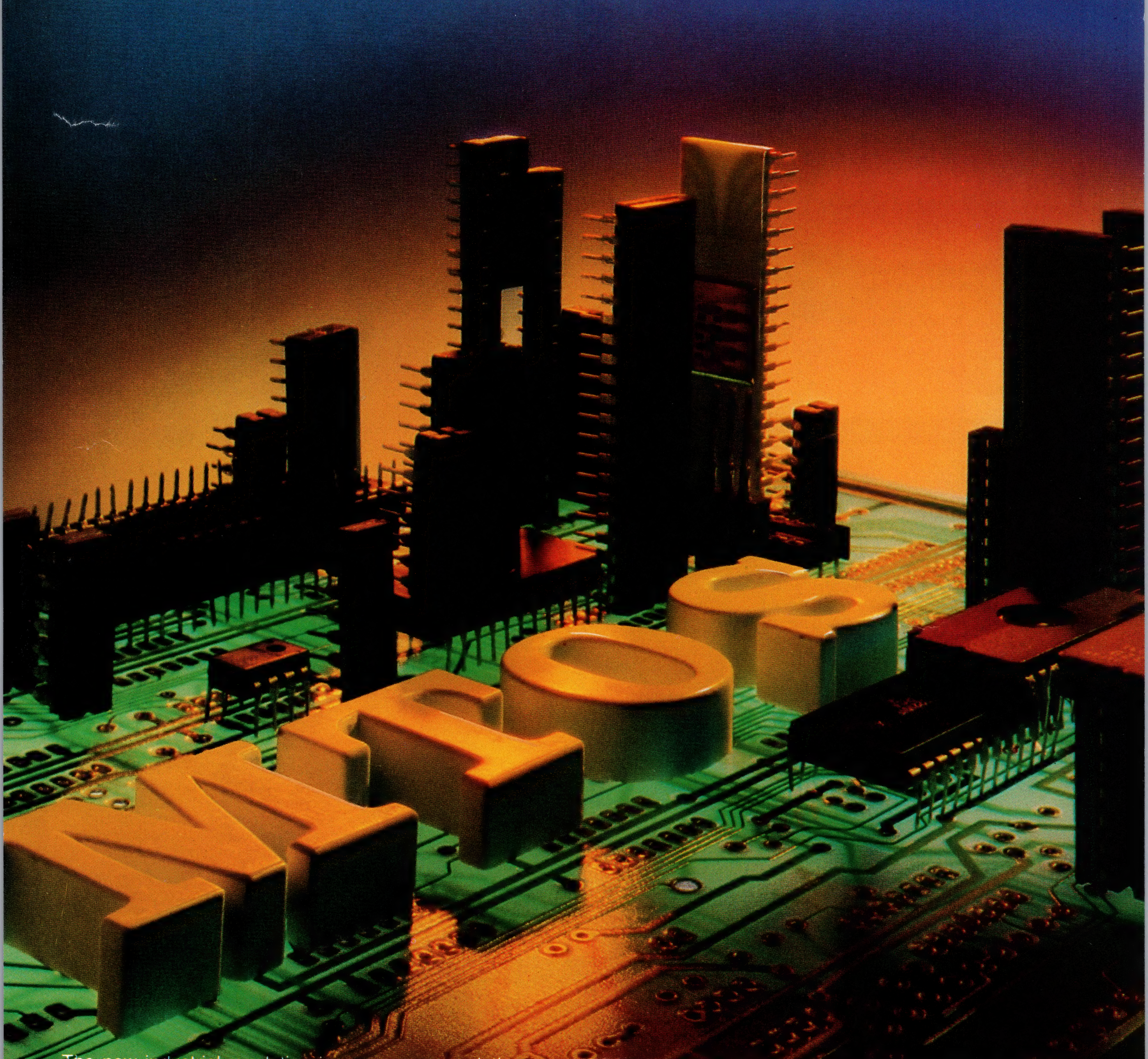
GI MOVES N. Y. UNITS TO ARIZONA SITE

General Instrument Corp. is packing up its Microelectronics Division headquarters and engineering departments and moving them from Hicksville, N. Y., to the division's manufacturing facility in Chandler, Ariz., say sources close to the company. A GI representative declines comment. The Microelectronics Division also has plants in Glenrothes, Scotland, and Taiwan.

AT&T INFO SYSTEMS HEADS OFF STRIKE

AT&T Information Systems averted a strike that would have kept 50,000 employees away from their jobs. The Communications Workers of America was protesting AT&T's new practice of subcontracting what it considers traditional union work—including clerical, janitorial, and delivery. AT&T, while not agreeing to employ union workers for these jobs, has agreed to keep the CWA informed about future subcontracting plans. Other disputes centered on an AT&T plan to eliminate 24,000 jobs in the next six months.

Real-Time Operating Systems for the New Industrial Revolution



The new industrial revolution is upon us; a revolution driven by microprocessor technology.

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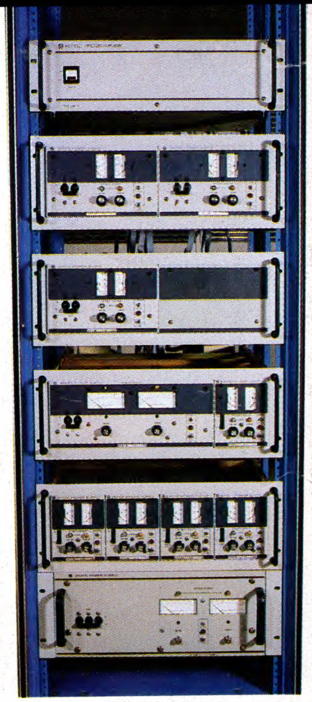

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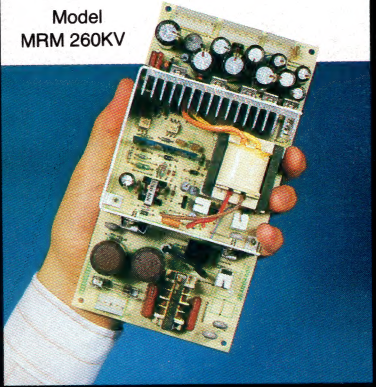

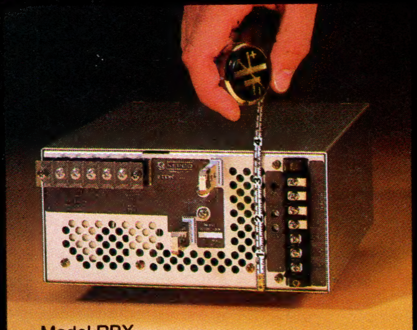

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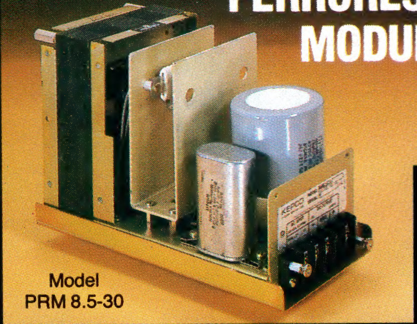

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